Manual

for

LaserCheck

Hardware Installation, Software and Maintenance

Version 1.6

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Table of contents:

1. Hardware Setup 4
1.1. Introduction 4
1.2. Requirements 6
1.3. Mounting of the Strain Gauges 7
1.3.1. Gluing 7
1.3.2. Wiring of the Amplifier 10
1.3.3. Function Test 13
1.3.4. Strain Gauge Offset Adjustment 14
1.3.5. Adjustment of the Strain Gauges 15
1.3.6. Loading Test 16
1.3.7. Connection of GSV threshold 19
1.4. Mounting the Sensors 20
1.4.1. General 20
1.4.2. LaserCheck 6 21
1.4.3. LaserCheck 7 23
1.4.4. LaserCheck 7/8 25
1.4.5. LaserCheck 9 26
1.4.6. LaserCheck 10/11 27
1.5. Configuring the Delem Control 28
1.5.1. Controller Setup 28
1.5.2. Network Configuration 28
1.5.3. Troubleshooting of Network Connection 28
1.5.4. UAP 28
1.5.5. Sequencer Modifications 29
1.5.6. Sequencer Flags 29
1.5.7. General Machine Parameters 30
1.5.8. Sensor Parameters 30
1.5.9. Bending Methods 31
1.5.10. Spring Back Calculation 32
1.5.11. Monitoring LaserCheck-Delem Operations 34
1.5.12. Four Sensor Option 35
1.5.13. LaserCheck Error Messages on Delem Control 35
1.5.14. Tools 36
1.6. Configuring the Cybelec Control 37
1.6.1. Hardware Connection to the Cybelec 37
1.6.2. Configuring the Cybelec-Software 39
1.6.3. Connection with Cybelec 40
1.6.4. Installing LaserCheck Software on ModEva 15 41
1.6.5. Sensor Distance and Pressure Sensitivity Control with DNC 41
1.6.6. Longitudinal Adjustment Control with DNC 42
1.6.7. Programming Machine Parameters 44
1.6.8. General Installation Remarks 47
1.6.9. Programming Bends 49
1.6.10. Easy Use of Spring Back Measurement Pages 51
1.6.11. Bends with Spring Back Measuring Variants 51
1.6.12. Bends without Spring Back Measuring Variants 53
1.6.13. Spring Back Measurement Results 54
1.7. Tandem Option for Cybelec 55
1.7.1. General 55
1.7.2. Installation 55
1.7.3. Tandem Definitions 55
1.7.4. Mode of Operation 55
1.7.5. Hardware 55
1.8. Wiring Schemes 56

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1.8.1. Wiring Scheme for LaserCheck 6 56
1.8.2. Wiring Scheme for LaserCheck 7 60
1.8.3. Wiring Scheme for LaserCheck 10 61
1.8.4. Wiring Scheme for LaserCheck 11 62

2. LaserCheck Software 63
2.1. License 63
2.2. Program Start 64
2.3. Program Options 65
2.4. General Settings 67

3. Image Processing and Angle Measurement 69

4. Laser Line Detection Parameters 71
4.1. Plausibility 72
4.2. Segmentation 72
4.3. Additional Camera Settings 72
4.4. Detection Results 73
4.5. Short flange compensation 74

5. Variable AOI (area of interest) 75
5.1. Die Definition 75
5.2. Switching the AOI 75
5.3. Additions for LaserCheck 10 and 11 76
5.4. Correcting the Calibration 76

6. Real Time Measurement 78
6.1. General 78
6.2. Cybelec 78

7. Sensor V-Adaption Control 81
7.1. Automatic V-Width Adjustment 81
7.2. Automatic V-Height Adjustment 82
7.3. V-Adjustment for bending 84
7.4. Automatic Longitudinal Adjustment 85
7.4.1. Driver parameters for Lexium ILS1 86
7.4.2. Electrical installation 87
7.4.3. Working Principle 90
7.4.4. Parameters from LaserCheck.par 91
7.4.5. Setting Up and Testing the Sensor for Longitudinal Adjustment 92

8. Material Surface Control 93

9. Automatic Write Protection (EWF) 95

10. Contents of the LaserCheck-folder 96

11. Troubleshooting 97

12. Safety and Maintenance Instructions 98
12.1. Safety of Laser Devices 98
12.1.1. Safety Instructions 98
12.1.2. General Instructions 98
12.1.3. Laser Classes 99
12.1.4. Laser Devices of Class 1M, Class 2, Class 2M and Class 3R 99
12.2. Daily Checks 100
12.3. Weekly Checks 100

13. General Specifications 101

1. Hardware Setup

1.1. Introduction

This chapter covers the installation of the **LaserCheck** angle measurement system on the press brakes
The installation procedure is divided into 4 steps:

1. Mounting of the force measurement system (strain gauges)
2. Set-up strain gauge (force) amplifier ranges
3. Mounting of Laser sensors
4. Configuring the press brake control

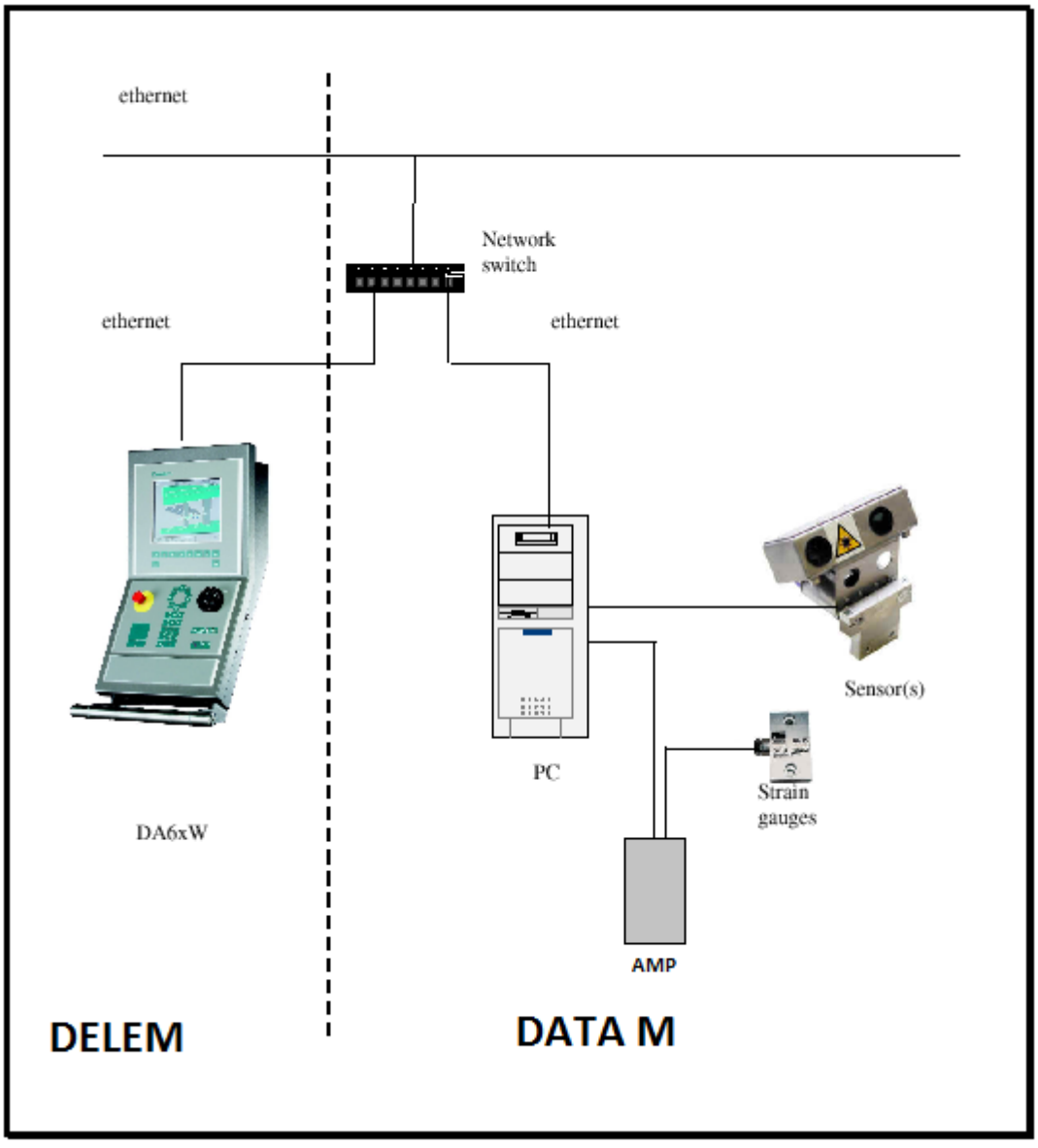

Figure 1: Schematic diagram of the angle measurement system with Delem-control

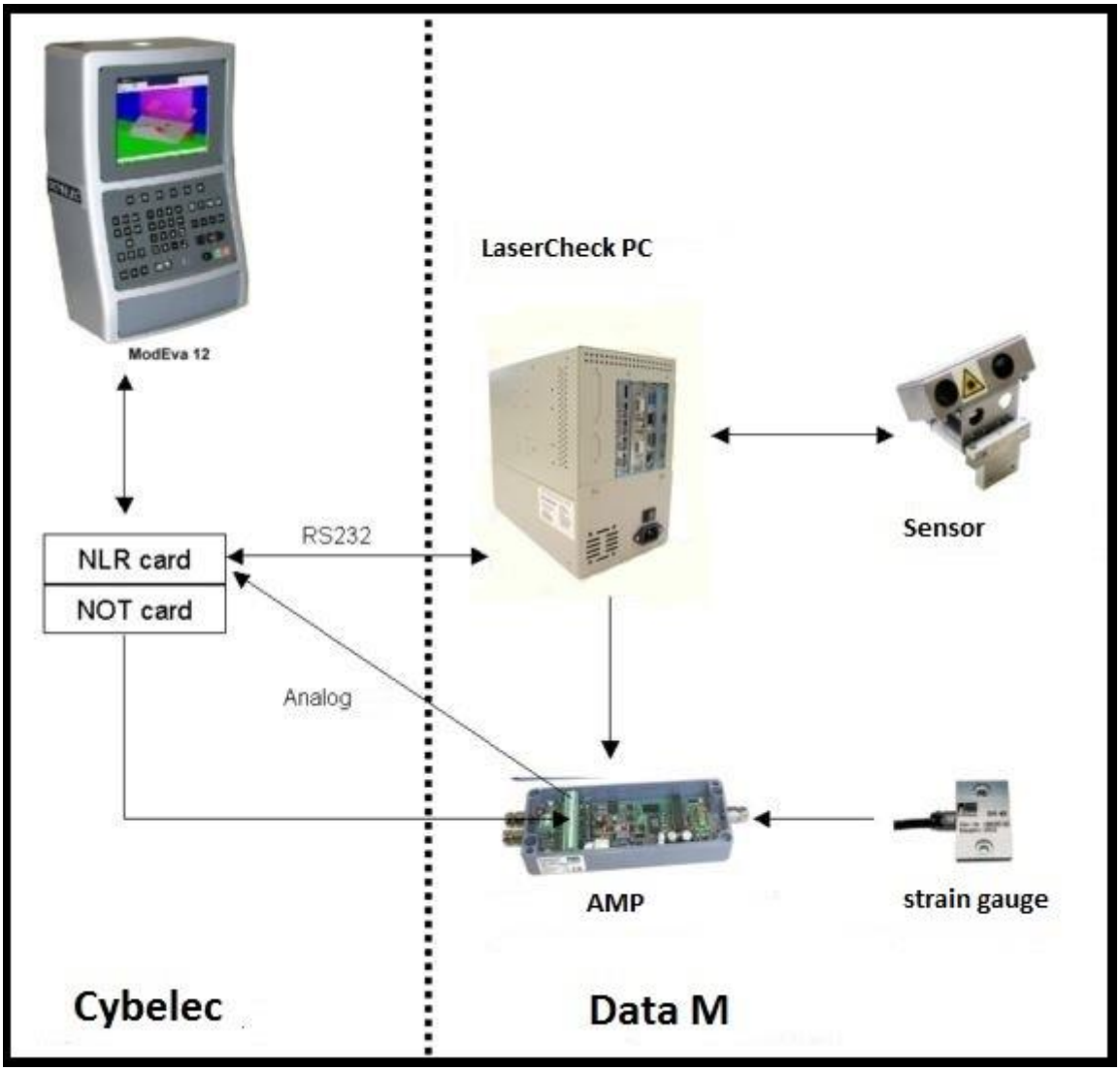

Figure 2: Schematic diagram of the angle measurement system with Cybelec-control

1.2. Requirements

- **V-angle of the die**
  The V-angle of the die must be considerably smaller than the smallest bend angle that should be formed with this tool.The maximum V-angle can be no bigger than the minimum bend angle minus the maximum expected spring back minus additional 5 degrees.
  Example: For a bend angle of 90 deg and a spring back angle of 7 deg
  ➔ Maximum V angle ~ 78 deg
- **Die type**
  Do not use multi V dies or block dies. The V-angles of these are generally too big in order to bend 90 deg angles (86deg V-angle). The overall die width is too large especially for the small V-widths. Thus the minimum flange width increases with the overall V width.
- **Crowning**
  The crowning must be kept constant throughout the entire bending process. The bending process starts with the calibration of the strain gauges at the changeover point. If the crowning is adjusted right at the pinch point, verify that no additional deformations of the C-frames due to the movement of the bending beam are introduced, otherwise the spring back calculation will be incorrect.
- **Back gauge and ram mounting**
  The back gauge must be mounted in such a way that it does not influence the force measurement during the movement. The usual design, with the guides mounted on the side frame, requires careful adjustments and exact parallelism of the guides. The cylinder guides must also be exactly parallel as the movement on distorted guides may affect the reference force.
- **Ambient light**
  As the LaserCheck sensor is an optical system, you should avoid disruptive ambient light such as spot lights, direct sun light…
- **Rigidity of the C-frame**
  The softer the C frame, the higher the deformations during the bending process, and the better the results obtained for the force measurement.
- **Minimum sheet bending length**
  The minimum bending length depends on various factors such as:
  - The rigidity of the C frame
  - The design of the machine
  - The material of the sheet metal
  - The thickness of the sheet metal
  - The V-width of the die
  - ….

  The following rules generally apply:
  The minimum bending length becomes bigger,
  - the bigger the machine
  - the larger the V-angle at a lower force
  - the thinner the material
  - the lower the Young's modulus of the material
  - …
- **Positioning of the ram**
  The precision of the ram positioning has an important influence on the overall bending result. The ram must not overshoot and the minimum pressure of the hydraulic system must guarantee an upward movement (decompression cycle).

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- **Limitations due to the material**
  - **Optical properties: no** bright steel, **no** brushed surfaces parallel to laser beam
  - **No rusty surfaces,** as it results in high friction between sheet and die
  - **High yield point:** due to friction, the spring back measurement has a proportional error relative to the spring back angle. The higher the spring back the lower the bending accuracy
- **Collision between LaserCheck sensor and sheet metal**
  - In the case of a counter bend, care must be taken to ensure that a collision between the LaserCheck sensor and the sheet is avoided.

- **Hydraulic crowning**
  In the case of hydraulic crowing, it must be ensured that the hydraulic crowning is in position before the machine stops at the mute point, otherwise the reference force measurement tends to be wrong.

1.3. Mounting of the Strain Gauges

Mounting the strain gauges consists of two main steps. The first one is gluing the strain gauges onto the machine's C frame. The second step is wiring the strain gauges to their amplifier and to the LaserCheck computer.

1.3.1. Gluing

Caution! Do not take the strain gauges out of its packaging before mounting. Remove the protective plastic film only just before the assembly! Do not touch the strain gauges. Do not bring any adhesive onto the white sealing surface!

Figure 3: Strain gauge with adhesive

At first, look for an appropriate place to mount the strain gauges. Preferably this is on the outside of the sides, near the lower radius. Make sure that the strain gauges cannot be damaged by any component parts throughout the bending process.

Mark the spot and remove all paint. Drill two tap holes and deburr. Grind down the surface with sandpaper (granulation 240). Degrease it with acetone. For the cleaning of the surface use a cotton bud, which you need to move across the surface in one direction whilst turning it. The surface is only considered clean if the cotton bud remains clean!

Thereafter do not touch the application area again, and keep it free of dirt and grease. Remove the clip that separates the hardener from the resin. Knead the pack until the resin and the hardener are evenly mixed and have a uniform color. Pay attention to the corners of the pack during mixing. Mixing takes about three minutes. The adhesive remains workable for 30 to 60 minutes after mixing, depending on ambient conditions.

Take the strain gauge out of its packaging and remove the protective wrapping. Do not touch the strain gauge. Using a spatula or similar tool, carefully apply adhesive to only the SG. Place the strain gauge onto the processed area and screw it down at once. Gradually tighten the screws until the strain gauge sits flat on the surface.

Do not loosen the screws from here on, since this could damage the SG. ***Attention! You must not move the SG once it has been in contact with the machine. If you cannot mount the screws, lift the SG, then put the screws through the holes of the SG and screw them into the threads without the SG touching the machine surface. Use the screws to pull the SG to the machine surface.***

The hardening of the resin may take about **12h to 72h** or even more, depending on ambient air temperature. During this hardening period you must neither move the machine, nor the SG. Moreover, you should always keep a sample of the resin, to check if the hardening is correct. At ambient temperatures below 20°C, the sensor should be warmed up e.g. with a hair dryer to max. 70°C during the hardening process of the resin. The sensor can be loaded after the adhesive resin in the bag has hardened.

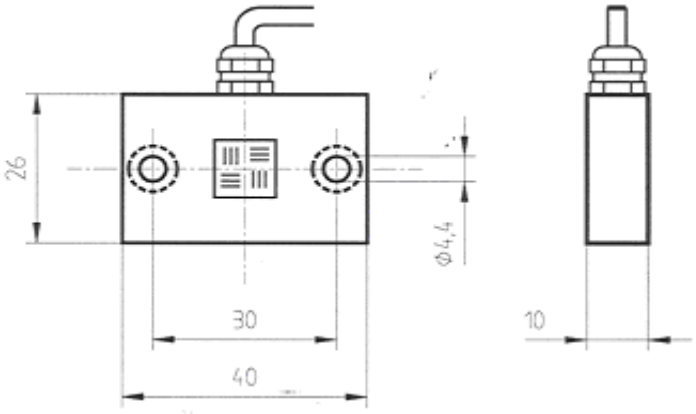


Figure 4: Positioning of the bore holes

Figure 5: Strain gauge DA 40 mounting example

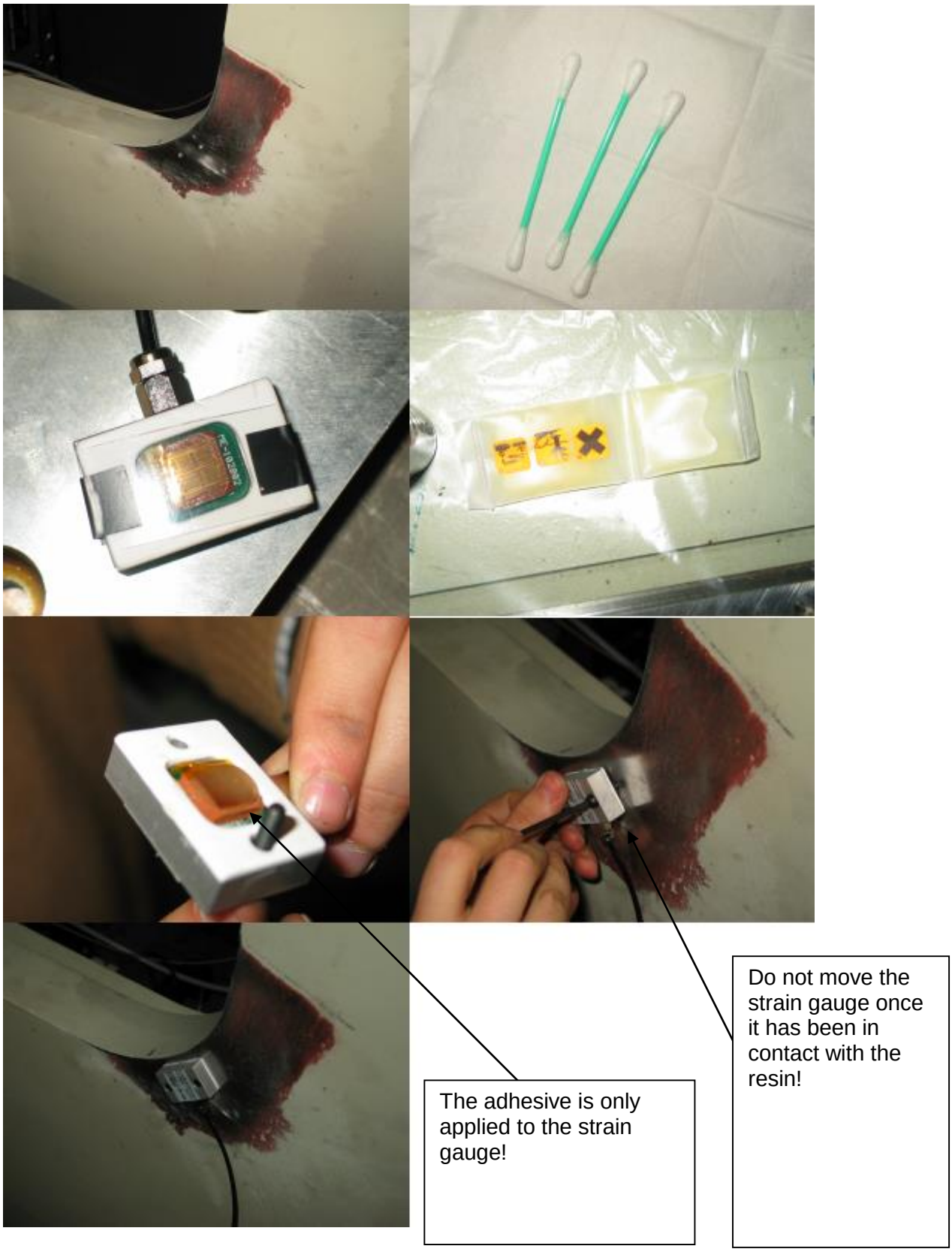


Figure 6: Pictures of the strain gauge DA 40 mounting: surface treatment, cotton bud, strain gauge protection, Epoxy resin, Epoxy resin on the strain gauge, fixation of the strain gauge, final mountings

1.3.2. Wiring of the Amplifier

This process consists of the connection of the strain gauges to the amplifier GSV-2 and its connection to the LaserCheck computer and to the Delem/Cybelec-control.

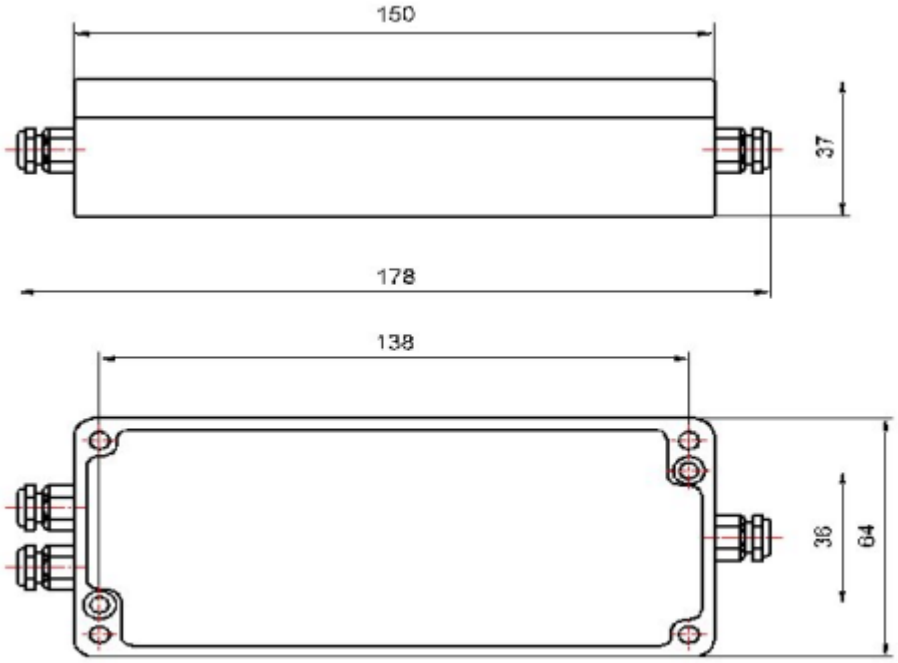


Figure 7: Size of the amplifier housing

Figure 8: Amplifier GSV-2

The amplifier already has two cables for the connection to the LaserCheck-computer (AMP and COM1). Via AMP the amplifier is supplied with power and the amplification levels are switched. The amplifier communicates with the computer via COM-port. **With Delem-systems, COM-port 1 is used.** With **Cybelec, COM-port 2 is used**, because COM1 is already used for a serial cable to the NLR.

At first, connect the two strain gauges in parallel to the clamps 1, 2, 4, 5, and 7.

The only external connections of the strain gauge amplifier are the power supply, clamp 14 on 24V, and clamp 15 on 0V. The strain gauge amplifier connections can be summarized in the following figure (Table 1):

Delem

	Clamp	*Color of sensor cable*	*Connection*	*Meaning*
Strain	1		GND	Power ground/ strain gauge shield
Gauges	2	Brown (Red)[3]	U_{S+}	Positive sensor source
	3		NC	
	4	Green	U_{D+}	Positive differential input
	5	Yellow (White) [3]	U_{D-}	Negative differential input
	6		NC	
	7	White (Black) [3]	U_{S-}	Negative sensor source
	8		NC	
	9		NC	
	10		NC	
	11		NC	
	12		T	Tara/Reset
	13		U_B	Source 24V
Power	14		U_B	Source 24V
supply	15		GND	Power Ground

Table 1: ME GSV-2 Amplifier Connection scheme for Delem controls (15 pin Clamp)

[3] Values in brackets only valid for older sensor types

Cybelec

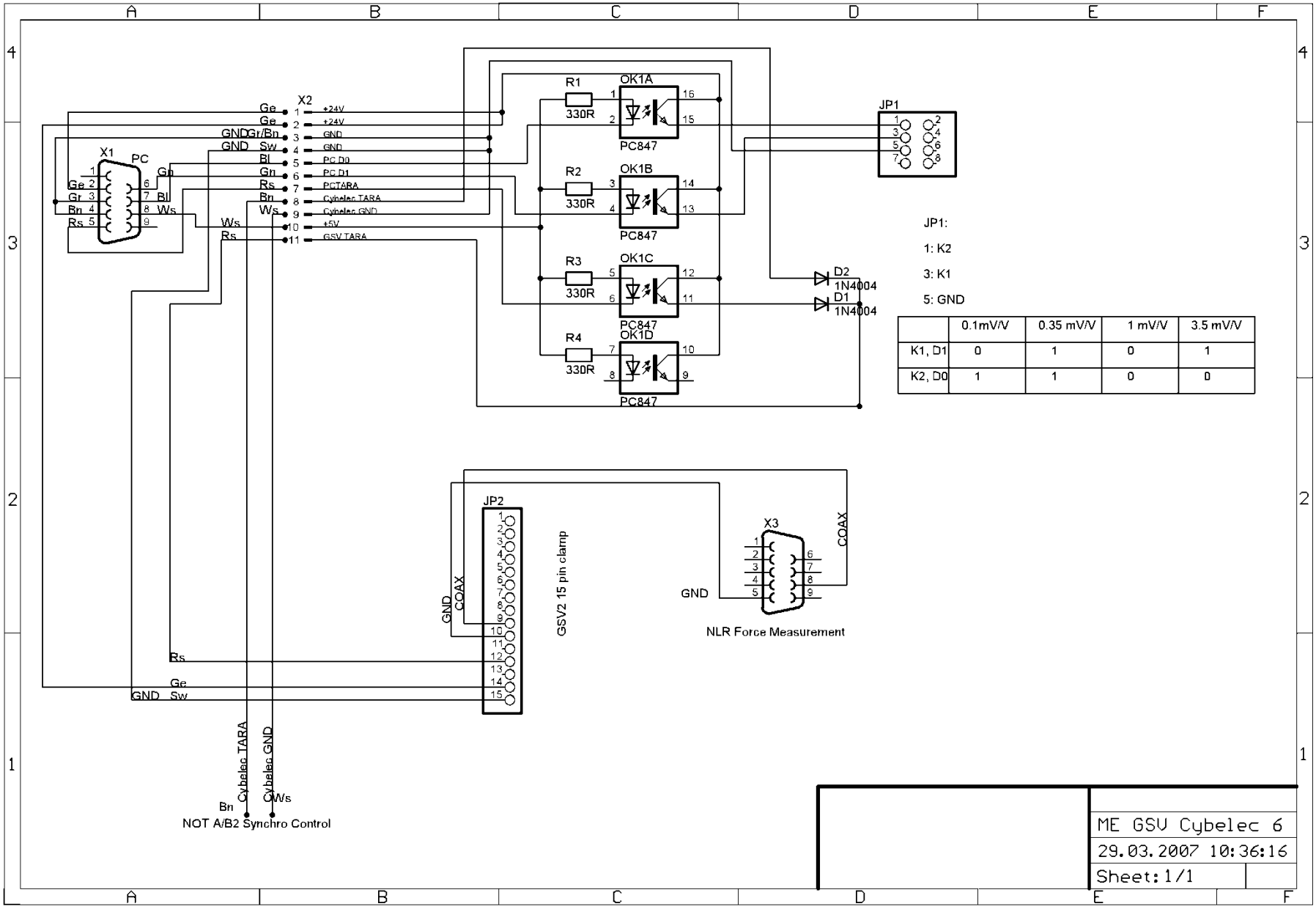
	Clamp	**Color of sensor cable**	**Connection**	**Meaning**	**Cybelec interface cards**
Strain	1		GND	Power ground/ strain gage shield	
Gages	2	Brown (Red)[3]	U_{S+}	Positive sensor source	
	3		NC		
	4	Green	U_{D+}	Positive differential input	
	5	Yellow (White) [3]	U_{D-}	Negative differential input	
	6		NC		
	7	White (Black) [3]	U_{S-}	Negative sensor source	
	8		NC		
Analogue signal	9	Coax	U_A	Analogue output (0...10V)[1]	NLR Force Measurement 1 Pin8[2]
	10	Shield	GND	Ground	NLR 0V Reference Pin 5
	11		NC		
Calibration	12		T	Tara/Reset	NOT A/B2 Synchro Control Pin 8
	13		U_B	Source 24V	
Power	14		U_B	Source 24V	
supply	15		GND	Power ground	

Table 2: ME GSV-2 Amplifier Connection scheme for Cybelec (15 pin Clamp)

[1]Standard NLR input for force measurement has a range from 0 to 5V; must be adjusted to 0-10V.

[2] 9 pin Sub D (Plug X5 of NLR card), [3] Values in brackets only valid for older sensor types

All cable shields should be electrically connected to the housing.


X1
PC
X2
+24V
+24V
GND
GND
PC D0
PC D1
PCTARA
Cybelec TARA
Cybelec GND
+5V
GSV TARA
R1
R2
R3
R4
330R
OK1A
OK1B
OK1C
OK1D
PC847
JP1
D2
1N4004
D1
1N4004
JP1:
1: K2
3: K1
5: GND
0.1mV/V
0.35 mV/V
1 mV/V
3.5 mV/V
K1, D1
K2, D0
JP2
GSV2 15 pin clamp
X3
COAX
GND
NLR Force Measurement
Cybelec TARA
Cybelec GND
NOT A/B2 Synchro Control
ME GSV Cybelec 6
29.03.2007 10:36:16
Sheet: 1/1

1.3.3. Function Test

For the functional test of the strain measurement system, the ME GSV-2 amplifier needs to be connected to the serial port of the LaserCheck PC via a serial cable. You can now run the program ME GSV Control which is already installed on the LaserCheck PC.

This connection is later used to track the actual strains (force) of the press brake.

GSV Clamp		**9-pin connector**		
A	GND	GND	5	White
B	RX	TX	3	Yellow
C	TX	RX	2	Green

Table 3: Serial connector of force sensor (ME GSV-2 Amplifier to PC COM1)

The main functions can be inspected even before the adhesive has fully hardened, by connecting the supply voltage U_S (red, black) and measuring the zero signal at the output U_D (green, white). The signal should not exceed ±3 mV/V. If it does exceed this value, the sensor requires compensation. See also the table on chapter 1.3.5.
The real functions, however, must be checked using a mechanical load on the press brake. The amplifier with option VX has 4 input sensitivity ranges that are set by the LaserCheck computer.

Turn on the press brake (24 V for the strain gauge amplifier). Move the upper tool to the top dead center. Check the supply voltage between clamp 14 and 15 (12 – 28V).

1.3.4. Strain Gauge Offset Adjustment

Normally these adjustments are already set by data M.
This procedure is used to compensate initial deformations of the strain gauges. Verify that the serial connection between your computer and the force amplifier has been established. Apply the following procedure:

1. Raise the beam to its upper dead center and mount the upper tools.
2. Run ME GSV.exe and select the **Advanced** tab.
3. Click on **Load Settings**. Select the manufacturer
4. Click on **Offset adjustment**
5. Set gain to **x1**
6. Set the data frequency to **100 Hz**
7. Click on **Save** and save as **User 1**. User 1 corresponds to **configuration 2** in the LaserCheck program.
8. Close the program and switch off the 24V power supply of the force amplifier. The new settings of the measurement amplifier have now been saved.

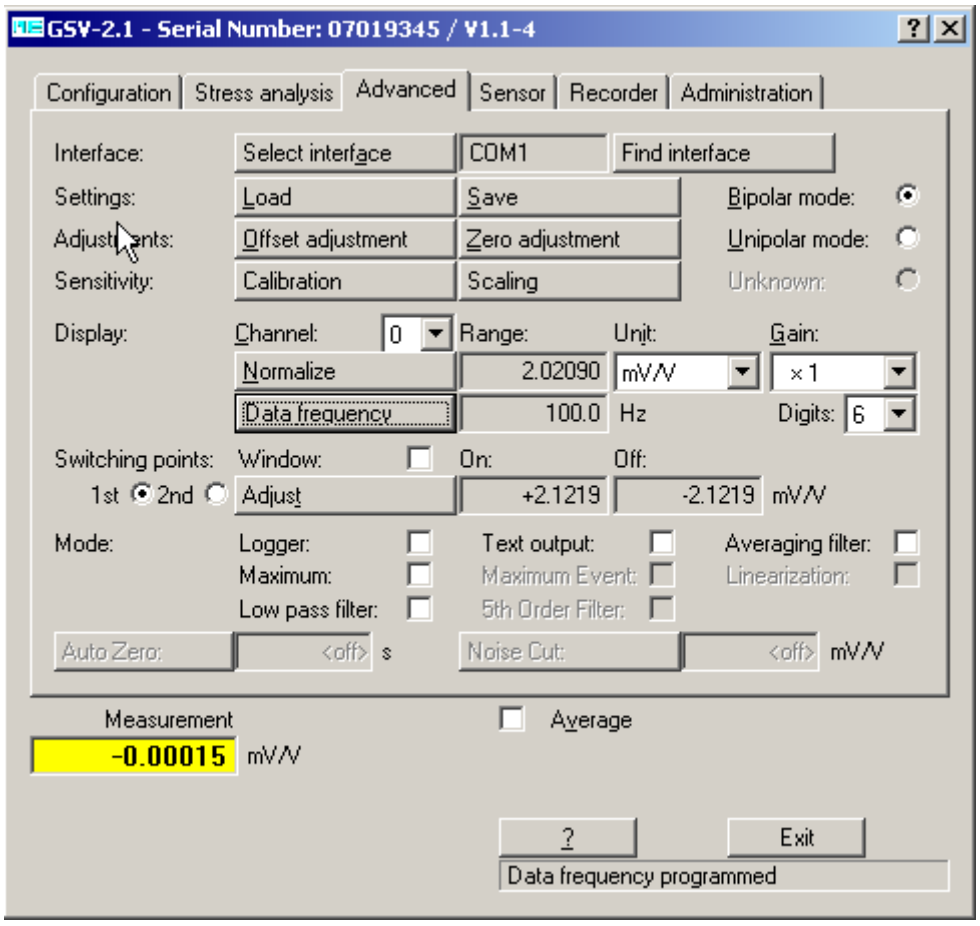


Figure 9: ME GSV Control program – Advanced tab

1.3.5. Adjustment of the Strain Gauges

If the amplification of higher values (0.1mV/V or 0.35mV/V) does not work and the GSV does not produce a value, the bridge might already be under load and the zero offset is failing. In this case it is necessary to compensate the bridge with an additional resistor.
Solving this problem:

1. Open the cover of the amplifier
2. Measure the voltage between clamps 4+5
3. If this voltage is higher than 0.5 mV:
    - Choose the resistor from the table:

U[mV]	R[kOhm]
0,25	437
0,50	219
0,75	146
1,00	109
1,25	87
1,50	73
1,75	62
2,00	55
2,25	49
2,50	44
2,75	40
3,00	36
3,25	34
3,50	31
3,75	29
4,00	27
4,25	26
4,50	24
4,75	23
5,00	22
5,25	21
5,50	20
5,75	19
6,00	18
6,25	17
6,50	17
6,75	16

Table 4: Compensation resistors

    - Place the resistor between clamp 2 and 4, if the voltage is positive or between 2 and 5 if the voltage is negative.
    - The voltage must now be below 0.5 mV
4. Check the output signal with MEGSV.exe. The last digits of the signal must change and not stay at 0.0000

1.3.6. Loading Test

The amplification range of the force sensor is adjusted with the help of the programmed force for each bend. Hence the measured value for the strain of the side stands needs to be aligned with the actual bending force. This is best done using test bends. Alternatively (e.g. for very large machines or if not enough suitable test sheets are available), the strain can be estimated using a manometer. During the tests you can track the measurements with the oscilloscope function of the ME GSV software. The range limits must be adjusted individually for each press brake type.
Note: Press brake controllers send the calculated bending force in [t] (e.g. Cybelec) or in [KN] (e.g. Delem)

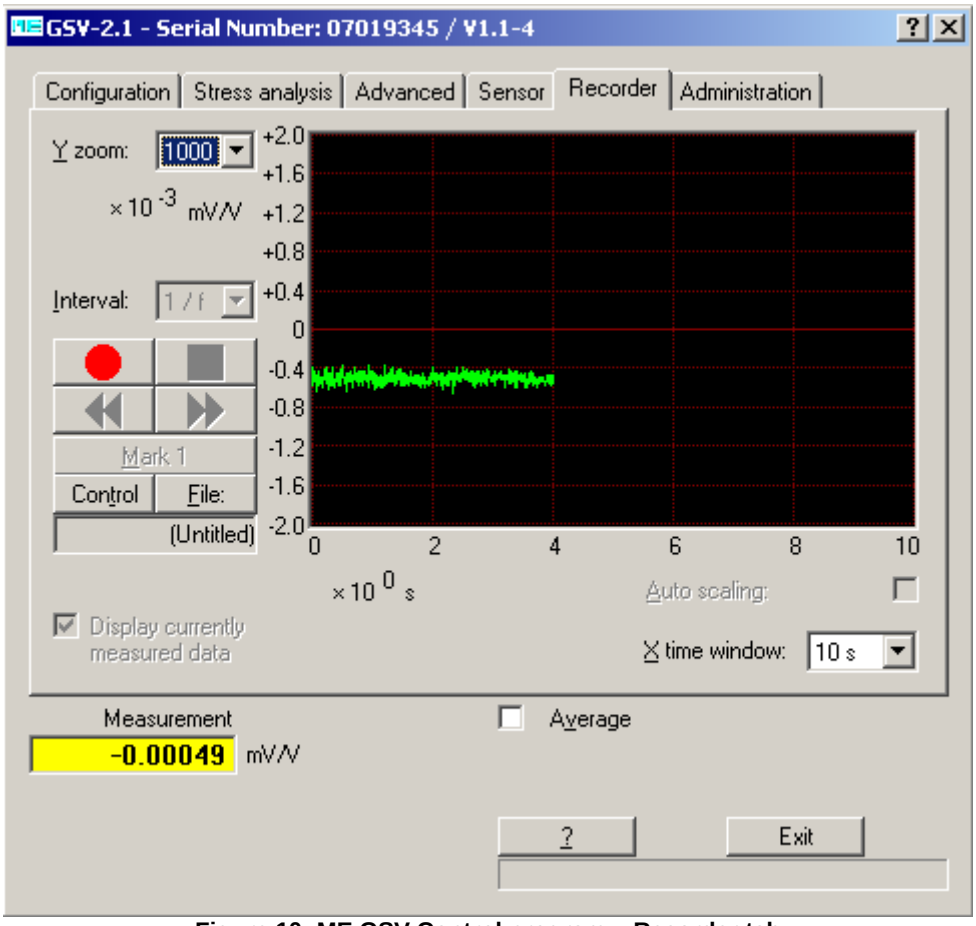


Figure 10: ME GSV Control program – Recorder tab

Before actually trying to measure a force, you should check the electromagnetic compatibility. EMC can cause electrical noise in the force signal. This will result in wrong spring back measuring results for smaller forces. Select the **Recorder** tab to check the EMC. Set the Y-zoom to 1000. The signal displayed must not exceed ±1.2 when all servo drives and the pump are running and the amplifier is set to its highest amplification level.

Reduce electrical noise with:

- Use of shielded wires for all motors
- Separate (linear) power supply for the amplifier.
- Careful grounding
- Separate cable channels for power lines and signal lines
- Avoiding spare wires (antennas!) in the cable channels.
- EMC-filters for servo drives

If the EMC-values are okay, you can perform the following test procedure:

Open the **Options/Force Measurement** dialog in the LaserCheck program. Estimate the amplification levels by entering the maximum force of the machine as the Force limit 4 and by each dividing the next smallest values by 3. Insert a value smaller than the first limiting value into the **Max. Pressure** field (e.g. 0). Click on the **Set** button. Check marks should appear in the Output Force 1 and Output Force 2 fields, depending on the respective amplification level. The limiting value that has been inserted is already part of the next highest amplification level. In order to test the force boundaries, you can use one of two methods:

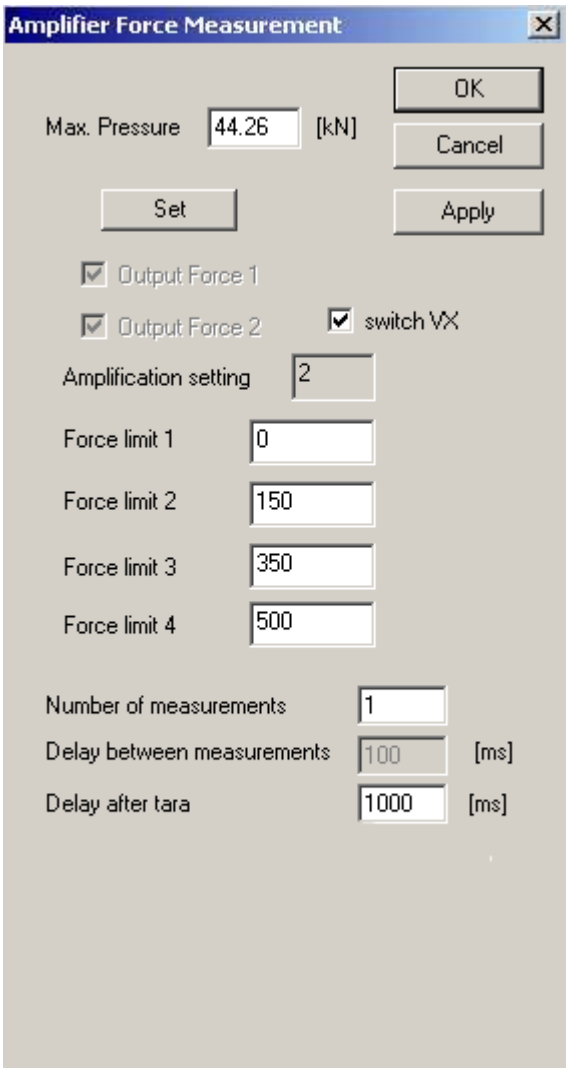


Figure 11: Dialog for controlling the max. pressure (Delem version)

1. **Alignment using the pressure method**

1. Start loading the press brake gradually from 0 to 100% load and record the values you can read in ME GSV program. The values vary between ~0 and ~1.05mV/V. Also record the corresponding pressure values indicated on the press brake control.
2. When you read a value above 0.75, change the current Max. Pressure setting to the next range. Press the **Set** button**.** Different check marks should now appear in the Output Force 1 and Output Force 2 boxes. When you change the amplification range, a significant change in the force readings should be observed.
3. Continue loading the machine. When a value above 0.75 is reached, you should switch to the next range by entering a higher **Max. Pressure** value.

2. Alignment using test bends

1. Program a test bend with a calculated force value of roughly half the size of the first force limit and enter this value into the **Max Pressure** field**.** Click on **Set**.
2. Perform a bend without any angle measurement and note the value of the maximum pressure shown by the control unit.
3. Calculate a new limit at which a value of 0,75mV/V will be shown and enter this as the first force limit.
4. Check this limit by performing a test bend with a value a little below this one. If necessary correct the force limit.
5. As force limit 2, enter a value about three times as big as force limit 1 and perform another test bend a little below this limit. Correct force limit 2 appropriately, in order to reach 0,75mV/V.
6. Repeat these steps for the other force limits.

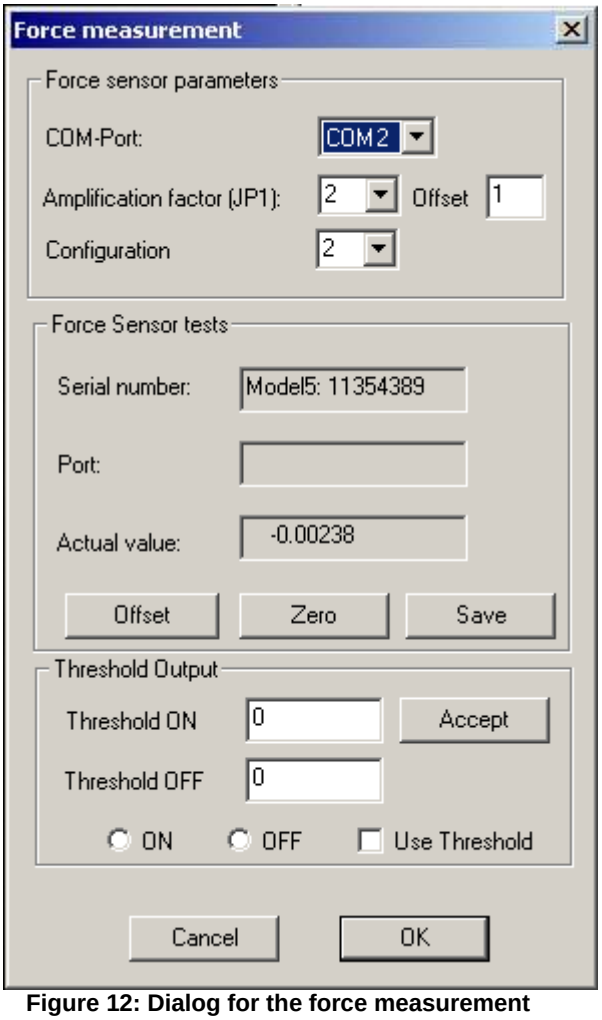


Figure 12: Dialog for the force measurement

In addition to the force ranges mentioned above, defined in the amplifier force measurement dialog, the overall sensitivity can be influenced by amplification factors 0 (low sensitivity) to 3 (high sensitivity) in the force measurement dialog. You can enter this window via **Options/Force Measurement.** If you change this setting and wish to save it you should click on the *Save* button.
In the example below (Table 5), the pressure values were read off a manometer, the values of the columns Range 1 to Range 4 were read off the force measurement dialog and the load was calculated from the pressure. From this chart you can now obtain the limits for the different force ranges.
We have obtained the force limits 10, 35, 100 and 170t.

Load [t]	Pressure[bar]	Range 1	Range 2	Range 3	Range 4
0	0				
2.83333333	5	0.3800			
10.2	18	0.4600	0.1200		
14.1666667	25	0.7400	0.2000		
17	30		0.2700		
28.3333333	50		0.4920		
39.6666667	70		0.7600	0.2530	
56.6666667	100			0.3800	
70.8333333	125			0.4700	
85	150			0.5800	
99.1666667	175			0.6800	
113.333333	200			0.8100	0.2310
141.666667	250				0.2820
170	300				0.3400

Table 5: Sample chart for a sensitivity range determination

You can now enter these values in the dialog of the LaserCheck program. Do not forget to save the parameters.

1.3.7. Connection of GSV threshold

The threshold output of the amplifier can be used for Delem to detect the end of spring back. This is an open collector output.
For example:
Use a free input on a DM10x-module.
Connect clamp 11 (SW1) to DM104 pin 5 (Input). Connect clamp 15 (GND) to DM104 (0V).
Use a pull up resistor (1kOhm) between the input and +24V.
Threshold output, sensor parameter 16 of the Delem control needs to be set to 1 and the option **with threshold** must be set in the dialog box **force measurement** in the LaserCheck-program.
Modify the Sequencer according to the input number.

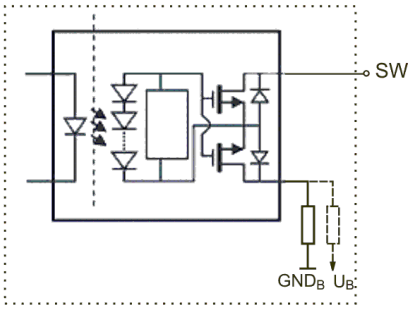


Figure 13: Connection of the threshold

Note: Using this option will require a low decompression speed of max. 3°/s. As you input the decompression speed in mm/s you have to convert the value according to sheet thickness and die opening!

1.4. Mounting the Sensors

1.4.1. General

The LaserCheck sensors must be mounted in pairs: one in the front and one in the back. For the correct sensor position refer to Figure 14 and following.
It is important to have

- The correct working distance (between the front face of the sensor and the sheet metal at 90°) between 110mm and 200mm. Please contact data M if you are not able to have this WD.
- the correct height between the top face of the die and the fixation screws
- the correct horizontal distance between the center of the die and the fixation block
- Take care that the front sensors in particular do not collide with the bending support.

Please refer to the following instructions and drawings for your system.

It is recommended to mount sensor 1 to the left front side, sensor 2 to the left backside, sensor 3 to the right front side and sensor 4 to the right backside. All systems are shipped with these default settings.

The horizontal reference is the machine center plane. The front and back sensors must be symmetrical to this plane. The horizontal movement is done by the stepping motors of the LaserCheck sensors. The movement is proportional to the V-width of the die. (LC6-7)

The vertical reference for the mounting of the sensors is the height of the die. If you intend to use different die heights, you must foresee a sensor height adjustment or use the option **VarAOI** (LaserCheck 8-11). The best solution is having pre-selectable heights which are defined by bolts. An **automatic height adjustment** is also available as an option. The height of the sensor must be adjusted in such a way, that the front edge of the die is not visible in the camera window.

The lateral movement of the sensors can be carried out by guide rails mounted onto the machine. These guide rails must be aligned parallel to the machine's center plane and to the tool table with a deviation of not more than +/- 0.05 mm. For instance, the sensors can be mounted onto the rails for bending support. It is also possible to mount the sensors onto a fixed position. This however reduces the flexibility of the system, as now the bending always has to take place at the same point on the machine. An **automatic longitudinal adjustment** is also available as an option.

All sensors without a motorized distance adjustment can be mounted on a variable die. The calibration must be done externally. Ensure that the calibration will copy the mounting situation exactly.

All cables connecting the sensors with the control computer must be protected in cable carriers. The control computer itself should be mounted in the electric cabinet with sufficient air conditioning and filtered air. Vibrations on the computer housing should be avoided.

Remarks:

1. ***Avoid plugging the sensors' cables in or out while the LaserCheck computer is switched on and running.***
2. ***Switching off the main power plug of the LaserCheck computer does <u>not</u> switch off the 24V external power supply connected to the LaserCheck computer.***

1.4.2. LaserCheck 6

Working distance: 200 mm

Height: 260.5 mm

Horizontal distance: 111.5 mm

Mounting angle: 45°

The required installation space is shown for a maximum course of the V-width adjustment of 65mm. The maximum V-width supported is 120mm. Please contact data M Engineering if you require a longer stroke.

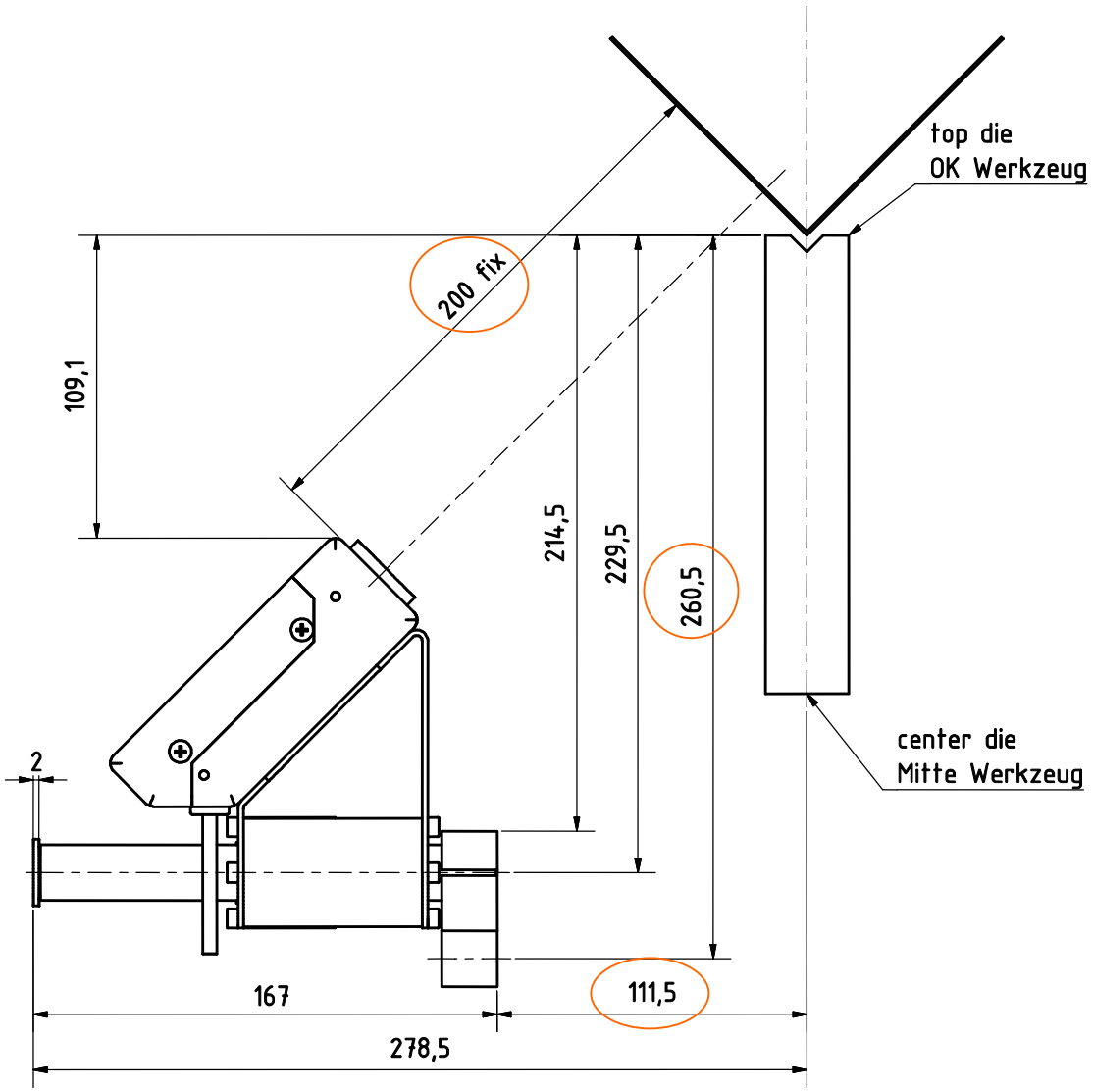


Figure 14: Mounting of the sensors – Side view

Note: The difference between LC6 U and LC6 G is the length of the plugs

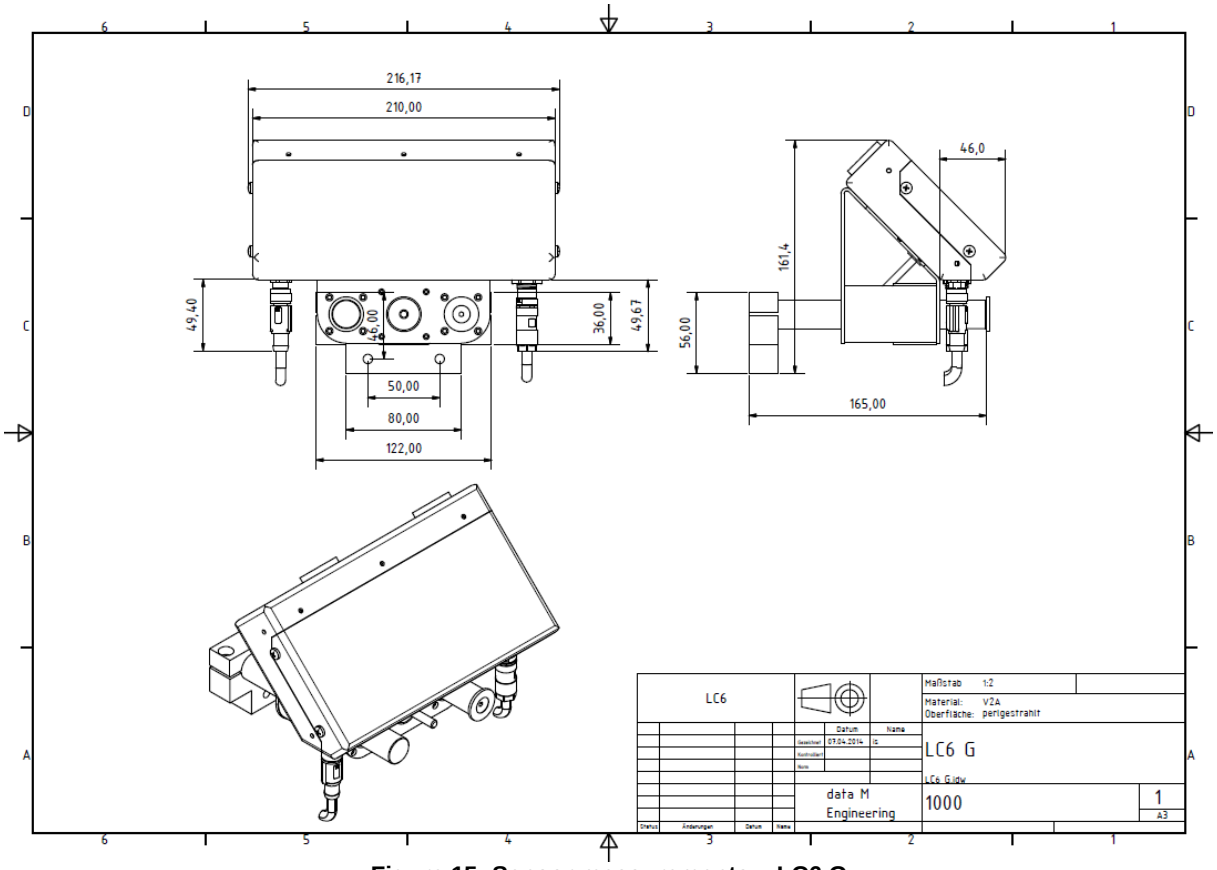


Figure 15: Sensor measurements – LC6 G

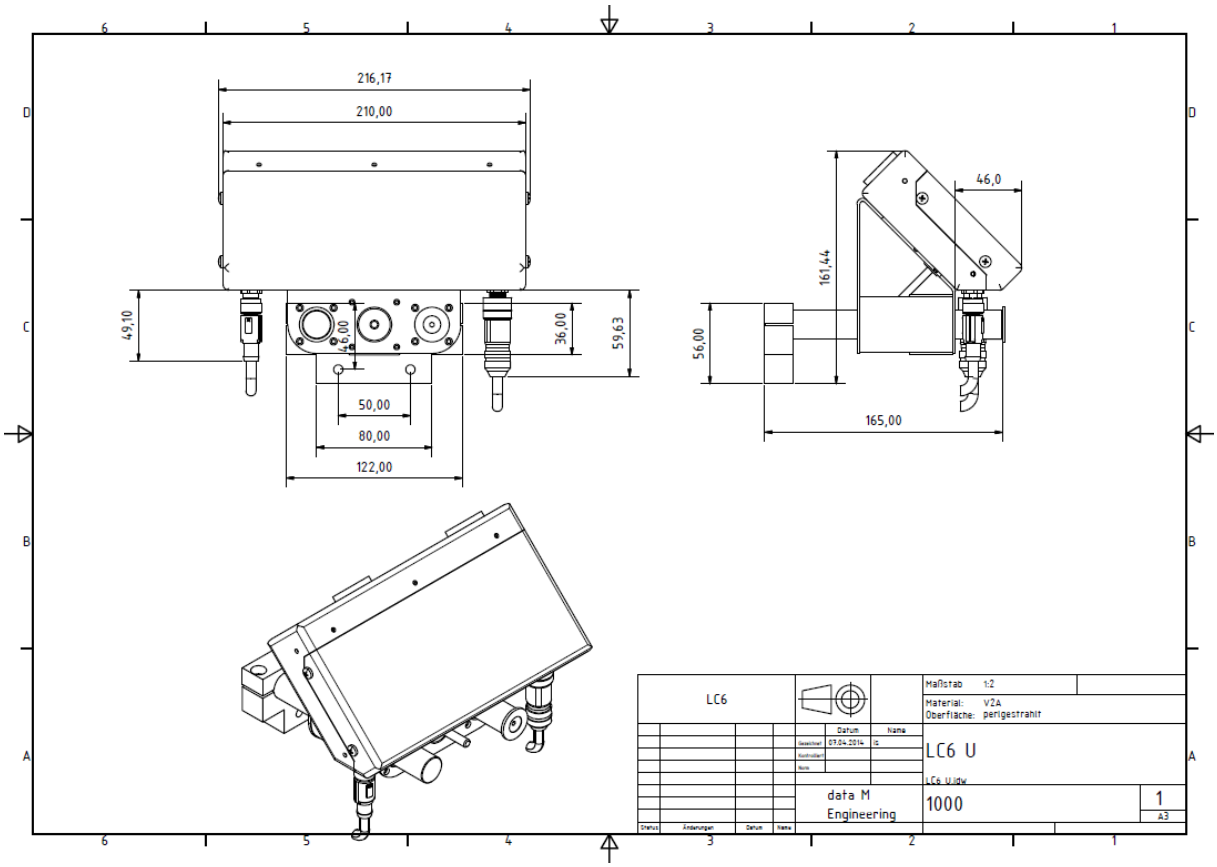


Figure 16: Sensor measurements – LC6 U

1.4.3. LaserCheck 7

- Working distance: 80-140 mm
- Mounting angle: 35°-60°

1.4.3.1. Setup of the Trinamic Stepper Motor Modules

LaserCheck 7 uses intelligent Trinamic stepper modules for width positioning. The Trinamic modules must be configured if a stepper motor module must be replaced or at the start of operation.
Each module needs an address and a reply address. The address is the same as the sensor number; the reply address must be twice the sensor number.

Sensor Number	Address	Reply Address
1	1	2
2	2	4
3	3	6
4	4	8

Table 6: Definition of addresses

The default addresses are 1 and 2.

Connect only one sensor to the computer, terminate LaserCheck.exe and start ***TMCL.exe***. **Please disconnect the power supply before you unplug the connectors.** Select **Setup/Options** and input the correct COM-port under the **Connections** tab.

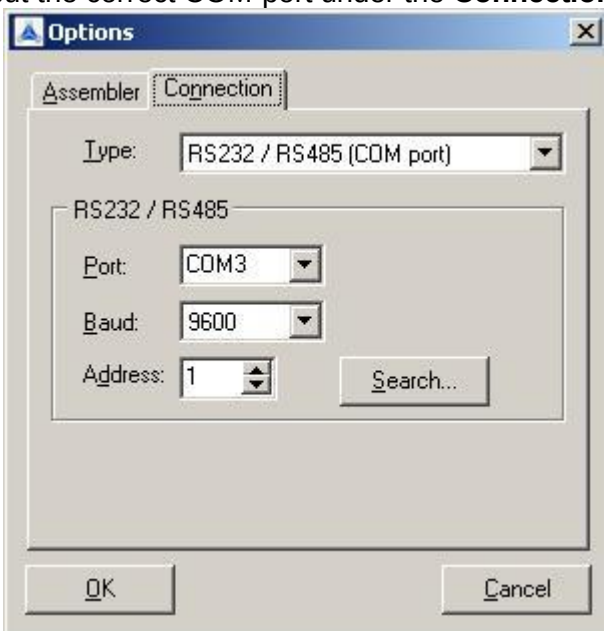


Figure 17: Connection data for the COM-port

Default baud rate is **9600**.Select **Search Module**. Press **Start**. The program should now find a module and represents this with a message box

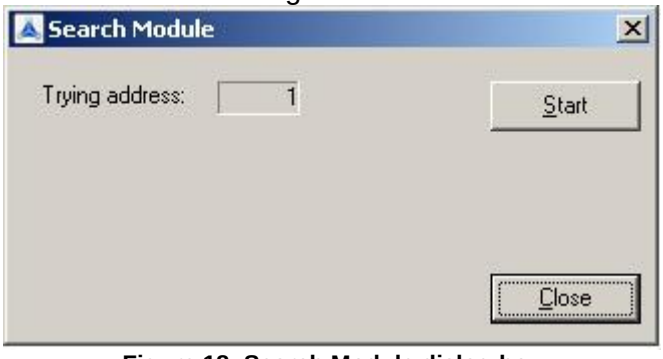


Figure 18: Search Module dialog box

Figure 19: Message box for a successful scan

- Program a new module address and reply address in Setup/Configure Module according to the address table. Confirm the new addresses with **Apply.**

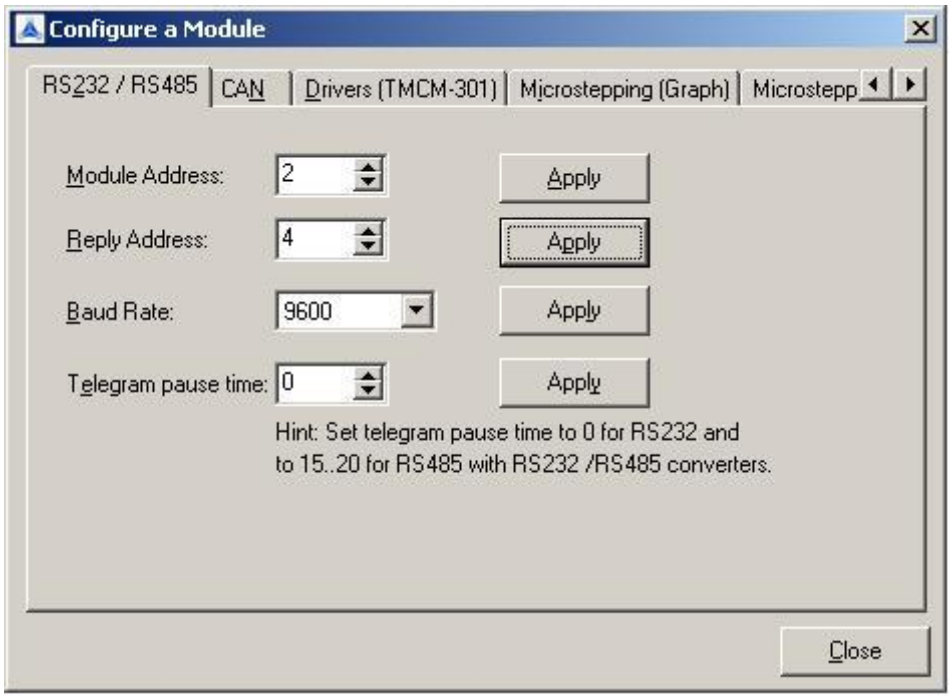


Figure 20: Configure a Mdule dialog box

- Verify the modification with **Search Module**. The Module must now be found at the newly programmed address
- Repeat this procedure for all modules

1.4.4. LaserCheck 7/8

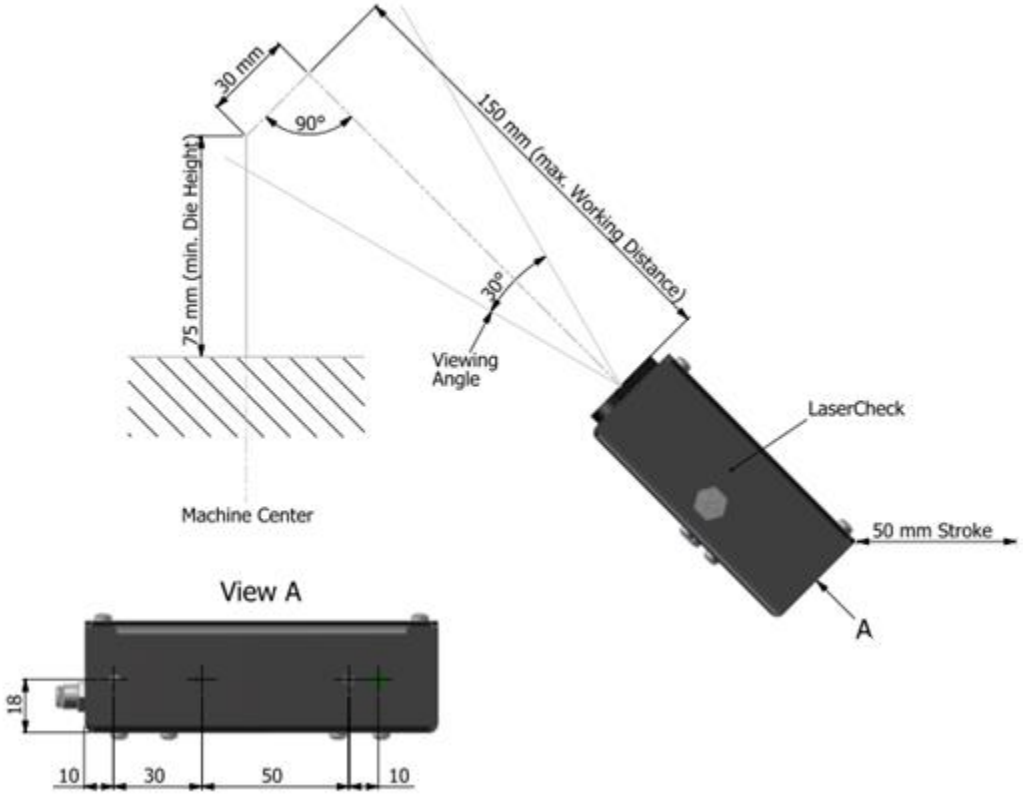


Figure 21: Working distance of LC 7 and 8

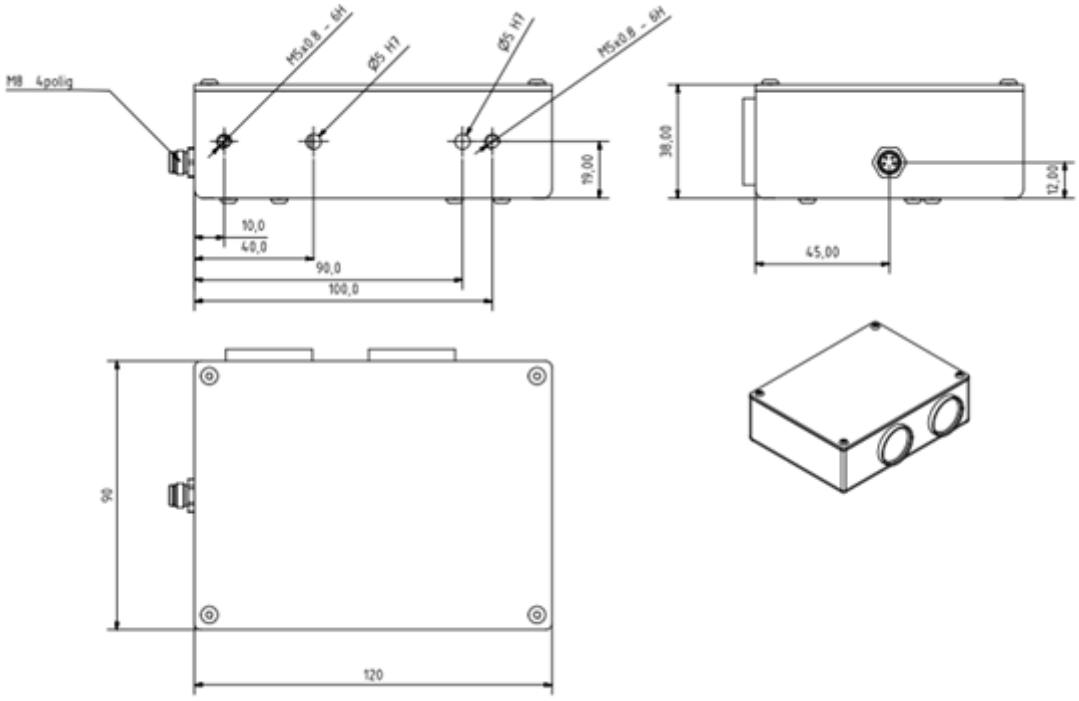


Figure 22: General sensor measurements of LaserCheck 7/8

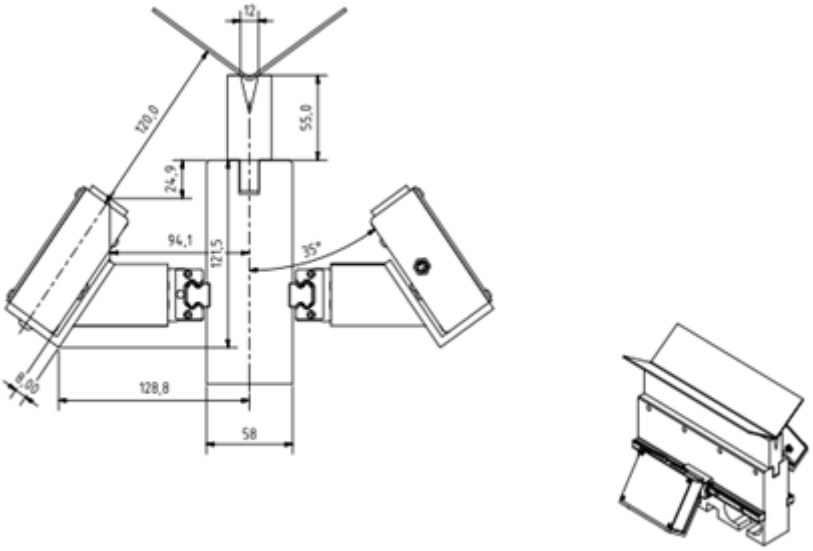


Figure 23: General mounting details for LC7/8

Figure 24: LaserCheck 8 sensor case

LaserCheck 7 and 8 have the same sensor case, but different connectors, since LaserCheck 8 uses a GigE-camera. The technical drawings apply for both sensors.

1.4.5. LaserCheck 9

- Working distance: 110-160 mm
- Mounting angle: 35° - 60°

1.4.6. LaserCheck 10/11

- Working distance: 50-150 mm
- Mounting angle: 35° - 55°

The sensor thickness is 44mm for LC10 and 53mm for LC11.

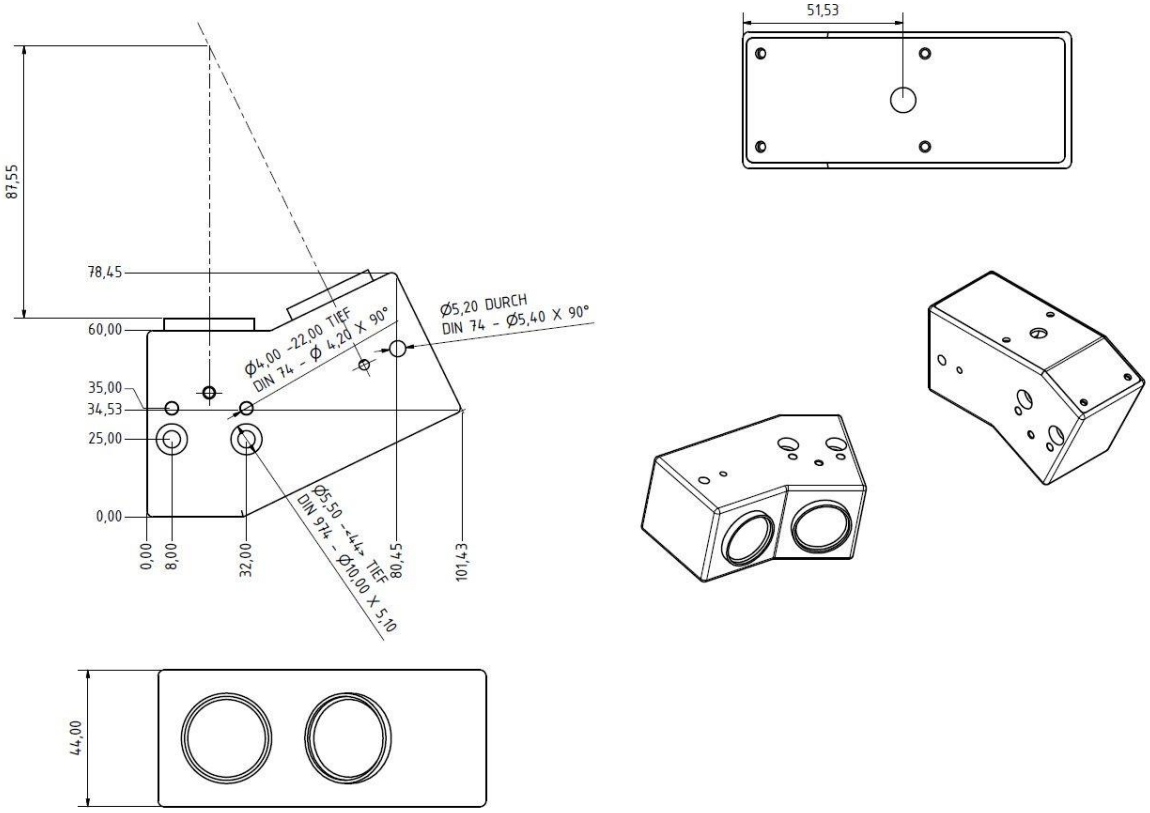


Figure 25: Mounting of LaserCheck10/11

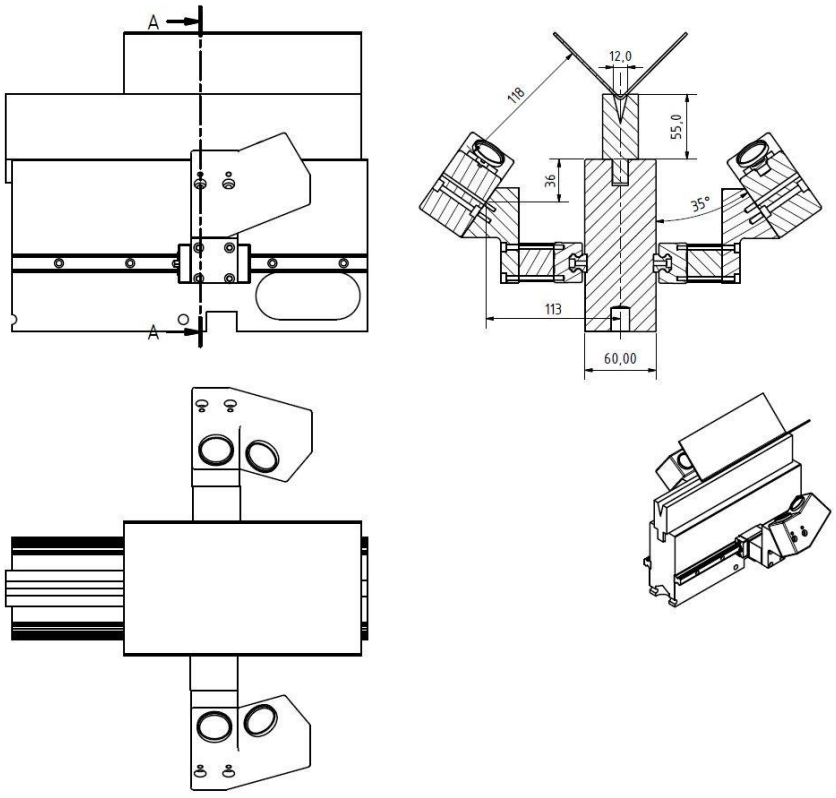


Figure 26: LC10/11 General mounting details

1.5. Configuring the Delem Control

1.5.1. Controller Setup

1. Go to **page 19.3** (Auxiliary axes).
2. Select **next available axis** and enable it
3. Choose axes **Sensor 1** and Control **Sensor**. If you are using 2 pairs of sensors, also enable Sensor 2.
4. Click on the **change parameter** soft key and select sensor numbers for the left (**1**) and right (**2**) sensors. If you only use 1 pair of sensors set Sensor 2 to 0. The sensor type can be Analog or Encoder.
5. When you now select bending mode 3, there should be a window in which you can see the number (1 and 25 default) of the selected axis. If the configuration was not successful, a message saying “no valid sensor” will appear once you start the controller.

1.5.2. Network Configuration

1. Change the **IP address** of the **Delem controller** to 192.168.144.184.
2. Change the **LaserCheck** computer’s **IP-address** to **192.168.144.183**.
3. Start the LaserCheck-program and open the “Press brake UDP network connection”-window. Go to **Connection/Settings** and enter the Delem controller’s IP-address.
4. Now go to Delem and change parameters 4 and 5 to the values shown at the bottom of the small window in the LaserCheck-program. You also have to enter port 4660 as parameter 6.
5. Run the program **SaveRegistry.exe** in the directory **\hard disk\WCE-Tools,** in order to save the new registry settings (IP address).

Remark:
This window **must always remain open** in order to be able to connect with a Delem press break control!

1.5.3. Troubleshooting of Network Connection

1. In order to check the communication between the Delem control and the Data M LaserCheck device, you can enable the display of all messages exchanged between the two systems in the *menu* **View/Messages** of the press brake connection window.
2. Check if the network connection cable is connected correctly and try to “ping” the Delem Control.
3. Do the IP address setting and the Delem IP address match? Do they use the same port?

1.5.4. UAP

1. Go to D:\data M Engineering\LaserCheck\Delem.
2. **For DAXXW:** Proceed to folder CE5 and copy the **UAP datam.dll** to the directory **\harddisk\Delem\Bin\uaps** of the Delem controller
3. **For DAXXT:** Proceed to folder CE6 and and copy the UAP **datam_uap_CE6_UDP.dll** to the directory **\Configuration\Delem\UAP** of the Delem controller.
4. Execute the program **SaveRegistry.exe** in the directory **\hard disk\WCE-Tools,** in order to save the new registry settings (IP address).

1.5.5. Sequencer Modifications

The Delem sequencer.txt (or seq_inp.txt) must be modified. In order to do so and hence stop the machine, the Y_T flag must be defined

Flag 7180 is used to stop the machine via the tandem flag.

Examples:
With robot

```
; Tandem
; LaserCheck uses Flags 7180 and 8039 (flag to monitor programmed y postion)
; Flag 7185: Sensor bending is active
;*******************
:1150:Y_T:=8039+SRFF(7089+C_STOP+7092+7095+DN(7180),(UP(Y_MUTE1)*7185)+UP(7180)+7
094*(UP(Y_MUTE1*Y_MUTE2)+UP(Y_PINCH)+(!7185*Y_BP)))
```

or standard machine sample:

```
;*************************************************************************
;  LaserCheck
;*************************************************************************
;
;Clear Sensor bending in UDP
;
:900:7185:=SRFF(UP(Y_UDP), 7185)

; Tandem
; LaserCheck uses Flags 7180 and 8039 (flag to monitor programmed y position)
; Flag 7185: Sensor bending is active
;
:901:Y_T:=8039+SRFF(C_STOP+DN(7180),(UP(Y_MUTE1)*7185)+UP(7180))

;*******************
```

With GSV threshold

```
:901: 7187:= %I02%05 ; 7187 is used to stop the machine when threshold is off
:902:Y_T:=8039+SRFF(C_STOP+DN(7180),(UP(Y_MUTE1)*7185)+UP(7180))+7185 * Y_STAT5 * !
7187
```

1.5.6. Sequencer Flags

Attention: Flags 7180-7199 must not be used elsewhere

Flag 7180 (I) is used to stop the machine
Flag 7181 (I) is adjusted after successful bend.
Flag 7182 (I) is the LaserCheck error flag.
Flag 7183 (I) is used to set the sequencer message indicating “reset reference bends for learnt bending”
Flag 7184 (O) is used to reset the references of the learnt bends of the robot. This flag is also used when the machine switches to Stop mode (C_STOP flag)
Flag 7185 (I) indicates active sensor supported bending.
Flag 7186 (O): When set, it prevents a reset of the reference from “mode change” to “Stop mode”.
Flag 7094 (O): Indicates Robot Mode
Flag 7191 (O): Indicates that crowning is in position

(I) : Flag is set inside the UAP
(O) : Flag is set externally to check the UAP

1.5.7. General Machine Parameters

These parameters are accessible on Delem Control via Page 19.3.1, Sensor Parameters.

1. **Decompression speed**: default **3** mm/s. **The decompression speed should not exceed 3°/s. Reduce the decompression speed according to the tool geometry if necessary!**
2. **Decompression distance**: default **2**mm
   During the spring back measurement, the ram releases the sheet. This parameter limits the maximum upward movement of the pressure cylinder. For certain materials with high spring back angles or larger V openings, this value can be higher.
3. **Pre bend angle** α: default **10deg**. The machine stops 10° before reaching the target angle.

1.5.8. Sensor Parameters

Sensor parameters are accessible on Delem control via Page 19.3.1.2 (default access code 32157). These parameters have to be considered machine parameters. They only have to be adjusted once for each machine.

1 **UAP_prog_y_pos_flag pre-**value in [1/1000 mm]
Standard value: **5**
Upon release the press control verifies every x [ms] whether the programmed position is reached. If so, the sequencer sets a stop flag. In order to prevent the upper tool from entirely releasing the sheet, we reduce the programmed y position by this value, so that the stopping condition has been achieved before the intended y position is reached.

2 **wait n * 20ms before sending a measurement request**
Standard value: **10**

3 **wait n * 20ms before changing from decompression to compression mode**
Standard value: **0**

4-5 **IP-Address** in TCP/IP's network byte order of the LaserCheck computer (default setting is 192.168.144.184)
IP 192.168.144.184 = 0xb890 0xa8c0 = 47248 43200
Calculation:

Decimal	Hexadecimal
192	C0
168	A8
144	90
184	B8

Make 2 byte groups, going from the last to the first value: B890, A8C0
Convert these values into decimal values

B890	47248
A8C0	43200

These values are calculated and displayed in the LaserCheck program. See page 10 in the LaserCheck software manual.

6 **UAP Port number**.
e.g. 4660. This value must match LaserCheck parameter 121.

7 **Number of steps in order to achieve an overbend angle**
Standard value: **2**
Once the spring back angle is determined, the machine will move to the final angle in n steps. Information collected during these steps is used for the target angle approach.

8 **Minimal movement of y-axis** in [1/1000mm]
Standard value: **10**
If the relative position value sent from LaserCheck to the Delem control during the bending cycle is below this limit, the bending cycle is terminated.
If a relative position value below this limit is calculated, it is sent to Delem control, as positioning below this value is not possible.

9 **Minimum force ratio RF_{lim} during spring back calculation** in [%]
Standard value: **30**
If the measured force during release is below X% of the maximum force, spring back can be calculated. Otherwise the program continues to release the upper tool until the force ratio has fallen below this value. If this value becomes too low, the sheet can move (rotate) inside the die.

10 **Target Angle offset for approaching programmed angle** in [1/100deg]
Standard value: **200**
In order to be able to perform a spring back calculation, we must be in the region of the target angle. In order to prevent the system from overbending, we need to approach the target angle with a safety factor, such as 90° + 2°

11 **Maximum allowed spring back angle** in [1/100deg]
Standard value: **1500**

12 **Overshoot before release (decompression)** in [1/1000mm]
Standard value: **15**

13 **Target value of force ratio for spring back calculation** in [%]
Standard value: **10**

14 **Period for communication timeout** in [200ms]
Standard value: 10 (2s).
If LaserCheck does not respond within this time period, up to 3 more requests will be sent. Should these requests also remain unanswered, an error will be indicated.
Using longitudinal adjustment requires a longer timeout. The timeout must be longer than the time needed for the longest stroke moving the sensors.

15 **Use mute point 2 for force reference** (1) or mute point 1 (0)

16 **Use the Threshold Output for End of spring back detection** (1) or not (0)

17 **Switch off Messages** (1.0) or not (0.0)

18 **Correction of y_mean for learnt bend** in 1/1000 mm

19 **Reserved – should be 0**

20 Used to indicate DAxxT (Touch) (1) or DAxxW (0) (only for CE6 UAP!)

Remarks:
Every time the LaserCheck system is connected to Delem, these parameters are sent from the Delem control to the LaserCheck system.
Parameters 7, 9, 10, 11 and 13 can be changed afterwards in the LaserCheck program for the current work session. If you want to change them permanently you must do so in the Delem control.
All other parameters can only be changed in the Delem control.

1.5.9. Bending Methods

1.5.9.1. Method 3 (Sensor Bending)
This method uses the angle measuring system for bending. We can choose between 3 sub-bend methods.

- Sub Bend Method 0 or 3
  Each bend is done with the LaserCheck system by measuring the spring back
- Sub Bend Method 1
  LaserCheck is only used for the first bending process. The result will be saved and used the next time, “learnt bend” is applied. This method only works in (semi)automatic mode.

- Sub Bend Method 2
  The system performs a bend without spring back calculation. The spring back angle is entered for the bend. Two further preliminary bending steps are performed before the final bend position is reached.

1.5.9.2. Method 4 (Learned Bend)

In order to accelerate the bending process of several bends of the same angle and in the same anisotropy of the sheet you can use option 4 in BM (Bending method). With the aid of a second parameter you have to refer to a bend step which has been performed before this bend and which has the same angle and sheet direction. This method only works in (semi)automatic mode.
The first measurement is a reference measurement with the angle measuring system. We save the obtained y-position and the spring back. For all other bends having the same reference number we will either use the same y position or the same spring back angle as for the reference bend.

The 2 modes are controlled by the sub bend method of the reference bend:

- Reference bend with sub bend method 0
  We use the y-position of the reference bend for the actual y-depth. No angle measurement system is used. This is useful in cases where the geometry does not allow any usage of LaserCheck.
- Reference bend with sub bend method 3
  We use the LaserCheck system without spring back calculation. The spring back angle of the reference bend is directly applied.
  The number of the reference must be lower than the current bend which will use this reference bend.

1.5.10. Spring Back Calculation

1.5.10.1. Working Principle

On the picture below we have an exampleof a bending cycle with spring back measurement.

1. Steps 0-2: pre bend and nominal angle approach
2. Steps 3-4: unloading for spring back calculation
3. Steps 5-6: overbend angle approach

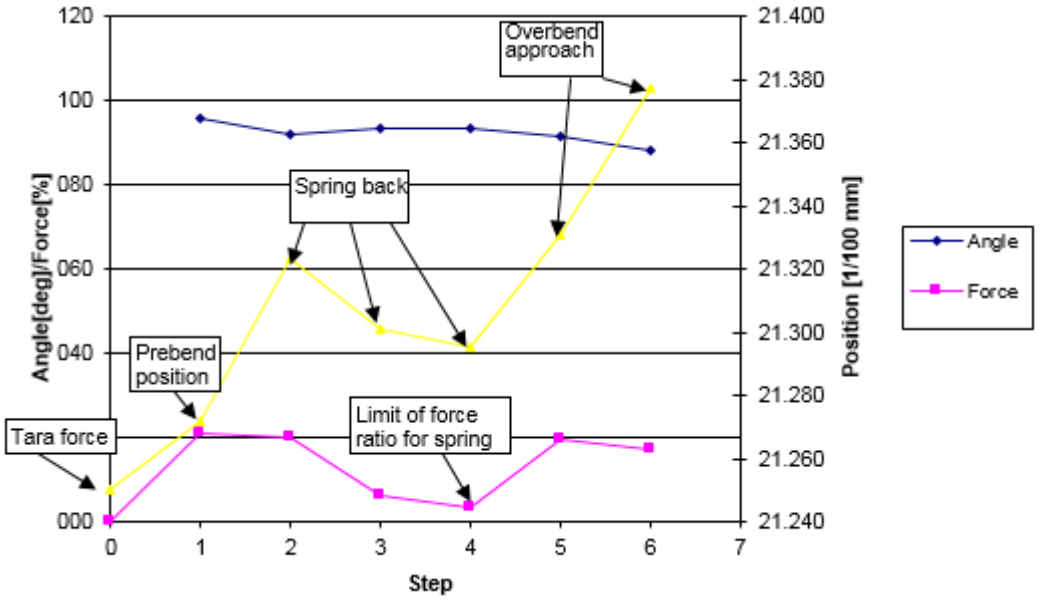


Figure 27: Example of a sensor bending cycle

1.5.10.2. Bending Process Parameters

The bending process parameters can be accessed via the menu Options / Bending process (Function key F4).

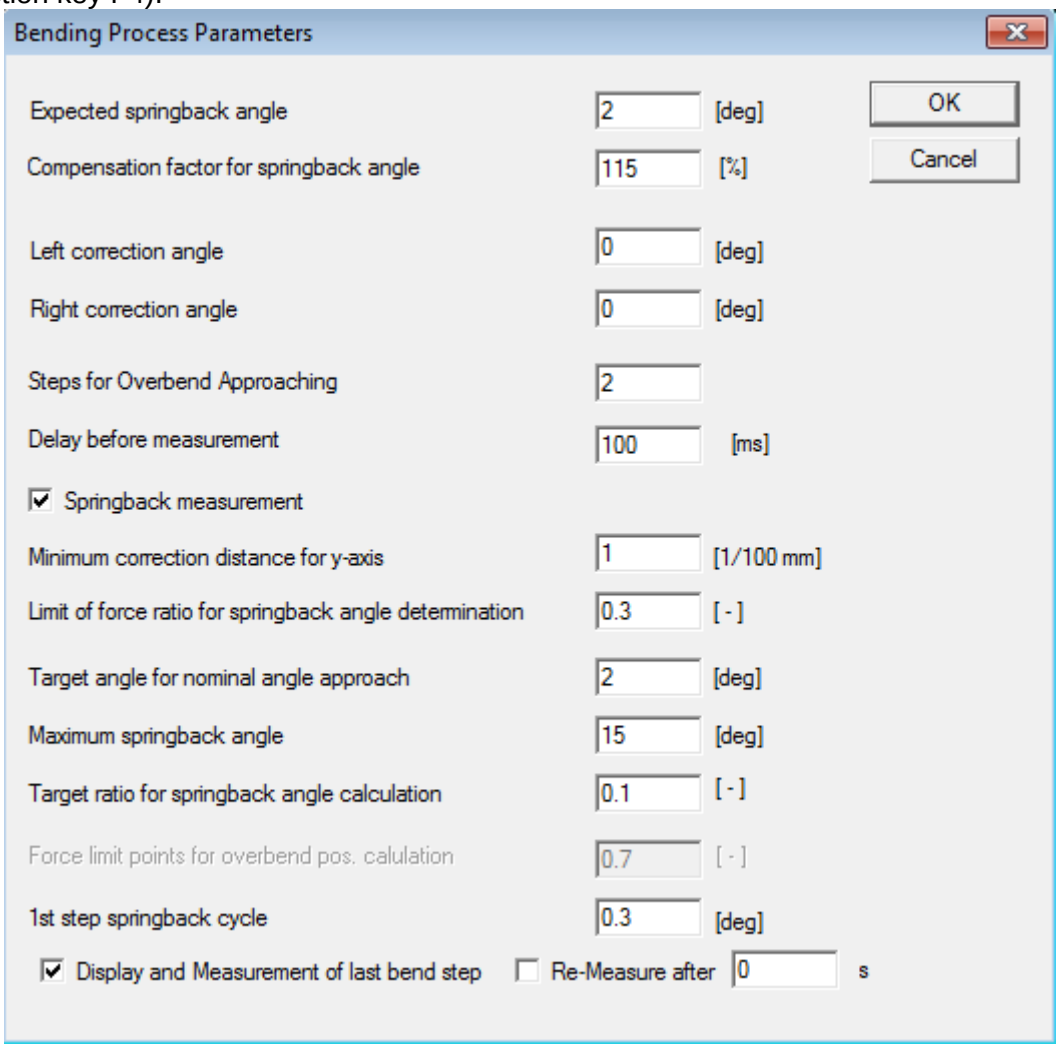


Figure 28: Dialog of the bending process parameters

The first 4 parameters in this dialog must be adjusted for each bend in manual and automatic mode. If you write a program you must adjust these parameters beforehand. These parameters are sent to LaserCheck before each bend. If the values are 0, the LaserCheck control will use its own default values.

- **Expected spring back angle** in [deg]: **2°**
  This value depends on the material and the V-angle used. If this value is too far away from the actual spring back angle, the machine will perform more cycles in order to lift the upper tool, until the Minimum force ratio RF has fallen below the limit RF_{lim}. Moreover the results become less precise the more cycles are performed.
- **Compensation factor for spring back angle** in [%]: **115%**
  The calculated spring back angle will be altered by this compensation factor.
  If value = 100% no changes will be made.
  If value > 100% the angle decreases.
  If value < 100% the angle increases.
- **Left correction angle** in [deg]: **0°**
- **Right correction angle** in [deg]: **0°**

  The following parameters are machine parameters which depend more on the machine than on the bend:

- **Steps for Overbend approaching: 2**
  Once the spring back angle is determined, the machine will approach the final angle in n steps. Information collected during these steps is used for the target angle approach.
- **Delay before measurement** in [ms]: **100**
  Measurements will be taken after a delay of n [ms], in order to reduce potential vibration effects.
- **Spring back measurement**
  If you deactivate this switch, no spring back calculation will be performed. Instead, the expected spring back angle will be used as the real spring back value.
- **Minimum correction distance for y-axis** in [1/100mm]: **1**

  If the relative position value sent from LaserCheck to Delem is below this limit during the bending cycle, the Delem control will terminate the bend cycle.

  If a relative position value below this limit is calculated, we send an error to Delem, because positioning below this value is not possible.
- **Limit of force ratio for spring back angle determination (0-1) : 0.3**
  If the force measured during unloading (release) is below this limit of the maximum force, spring back can be calculated. Otherwise the program continues to release the upper tool until the force ratio has fallen below the limit. If the parameter is too small, the sheet can potentially move (rotate) inside the die. The value 0.3 means that if the force is getting below 30% of the maximum force the spring back angle can be calculated, if the force is still above 30% the beam must be released more.
- **Target Angle for nominal angle approach** in [deg]: **2**
  In order to be able to perform a spring back calculation, we have to be in the region of the target angle. To prevent the system from over-bending, we approach the target angle with a safety factor, for example 90° + 2°
- **Maximum spring back angle** in [deg]: **15**
  If the calculated spring back angle is above this limit, an error is sent to the Delem control
- **Target ratio for spring back angle calculation (0-1): 0.1**
  During the unloading process the system uses this value to extrapolate the final unloading position. 0.1 means that the target force is 10% of the maximum force measured.
- **Force limit points for overbend pos. calculation (0-1): 0.7**
  During loading only force points will be collected which have a force value above this limit
- **1st step spring back cycle** in [deg]: **0.3**

  Opening angle before starting the spring back measurement. This opening will take out some forces caused by friction between sheet and die. A typical value is 0.3°.

Remarks:

1. Every time the LaserCheck system is connected to the Delem control some of these parameters are sent from the Delem control to LaserCheck and are overwritten.
2. If you want to change them permanently, you must do so in the Delem control.

1.5.11. Monitoring LaserCheck-Delem Operations

1. Open the Delem window for messages exchanged between LaserCheck and Deleml. Measurement results and bending process data appear in the window.
2. If you select the menu item Options/Process results (Function key F7) for Elastic Recovery Results you can see the bending process results.
3. Activate Log file option (CTRL+L). A log file is written in the program directory D:\data M Engineering\LaserCheck\Logs/messX.log

1.5.12. Four Sensor Option

If your system is equipped with 4 sensors, the Y1 and Y2 positions of your ram are calculated independently. In the Delem control you have to enable both sensor pairs and provide the position values of the LaserCheck sensors. Of course you can still use only one pair of sensors which you must specify in the input dialog for the angle measurement system of the Delem control.
The control sends all information including the length between the cylinders and the total machine length to LaserCheck. Using the supplied data the system determines the correct Y1 and Y2 positions for the spring back correction.

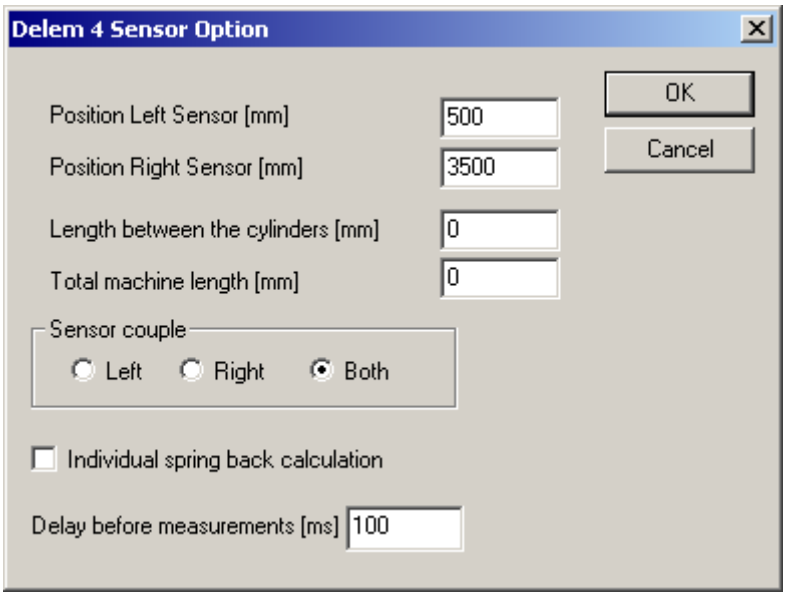


Figure 29: Sensor positions

Moreover, if you enable the switch **Individual spring back calculation**, for both axes, an individual spring back value is calculated for the Y1 and Y2 correction, if the system does not calculate an average spring back angle.

Important Note:

The origin of the machine's coordinate system must be located on the left side of the machine and not in its center!

1.5.13. LaserCheck Error Messages on Delem Control

- **ERROR Calibration**
  Problem with strain gauge amplifier
- **ERROR Max. course sensors V-width**
  Die V opening is too large
- **ERROR Press brake control. Positioning!**
  Check maximum decompression distance DC in Delem control or Y-axes positioning parameters
- **ERROR Reference force**
  Problem with strain gauge amplifier
- **ERROR Y_set == Y_actual. But not yet in final bending state**
  Measured spring back too small, problem with spring back calculation, measured bending forces too low
- **ERROR: Number of REPETITIONS > 5**
  Check estimated spring back angle and maximum measured force (bending forces too low)

- **ERROR: Number of RELEASE Steps > 10**
  Check estimated spring back angle and maximum measured force (bending forces too low)
- **ERROR: Overbend position**
  Calculated spring back too high. Problem with spring back calculation. Check angles and forces
- **ERROR: 1st Stop position too low**
  Check pre-bend angle Pα in Delem control
- **ERROR: Angle and Force measurement**
  Error with force and angle measurement
- **ERROR: Force measurement**
  Check for possible overload, force limits in LaserCheck, programmed force, bending length
- **ERROR: Angle measurement**
  Check visibility and quality of laser beam

1.5.14. Tools

LaserCheck reads the tool width and radius directly from the Delem control. The tool height can only be read indirectly via the tool name.
Therefore the tools used by Delem must be saved in the LaserCheck parameters, if either an automatic height adjustment is used or the option “Var. AOI” is activated when using LaserCheck 8, 9, 10 or 11.
That is the reason for the LaserCheck.par extension:

```
---------- Die definitions for Height Adjustment ----------
300 : 0                         // Selected Die
301 : OZU-053                   55
302 : OZU-045                   55
303 : OZU-051                   55
304 : OZU-063                   55
305 : OZU-351                   100
306 : OZU-352                   100
307 : OZU-353                   100
308 : OZU-354                   100
```

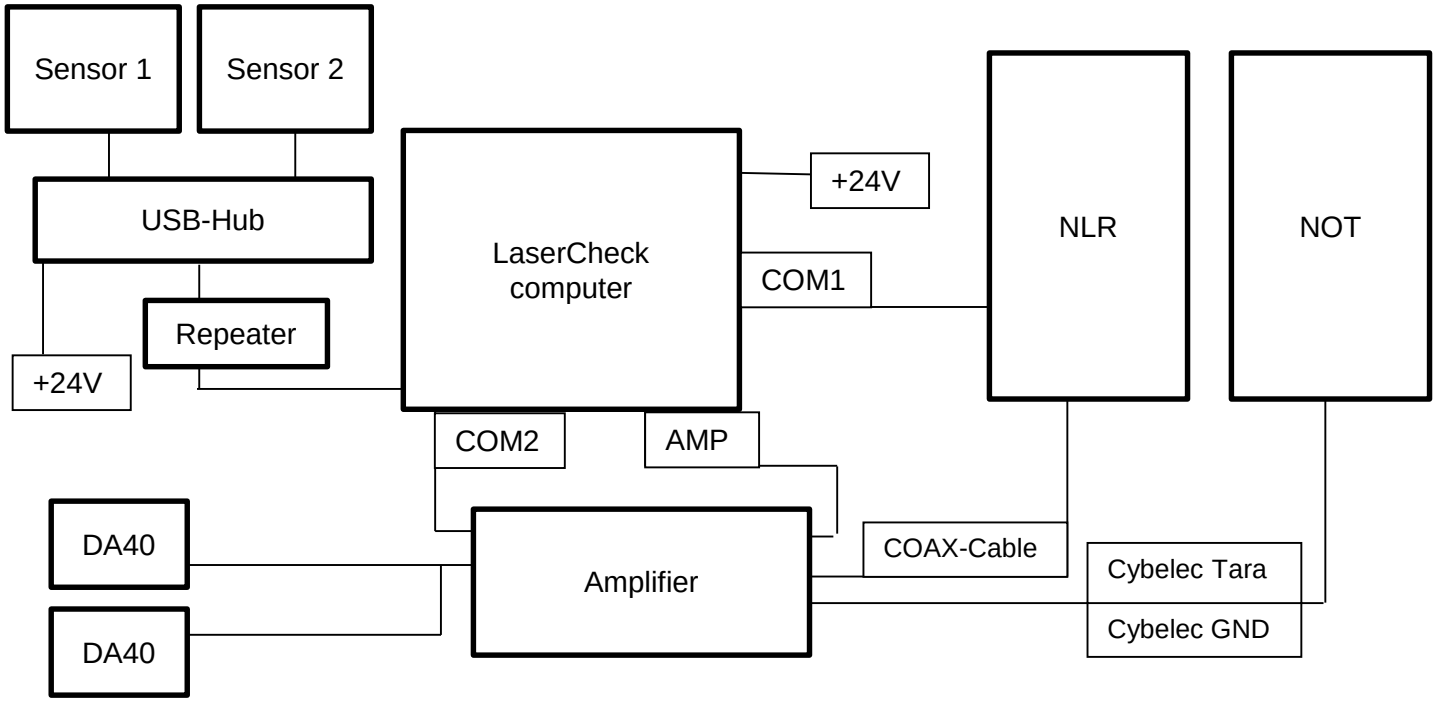
In line 300 is the index of the active tool, starting with line 301 there are first the tool names like the Delem control uses them and second the tool height. You can save as many tools as you want.

1.6. Configuring the Cybelec Control

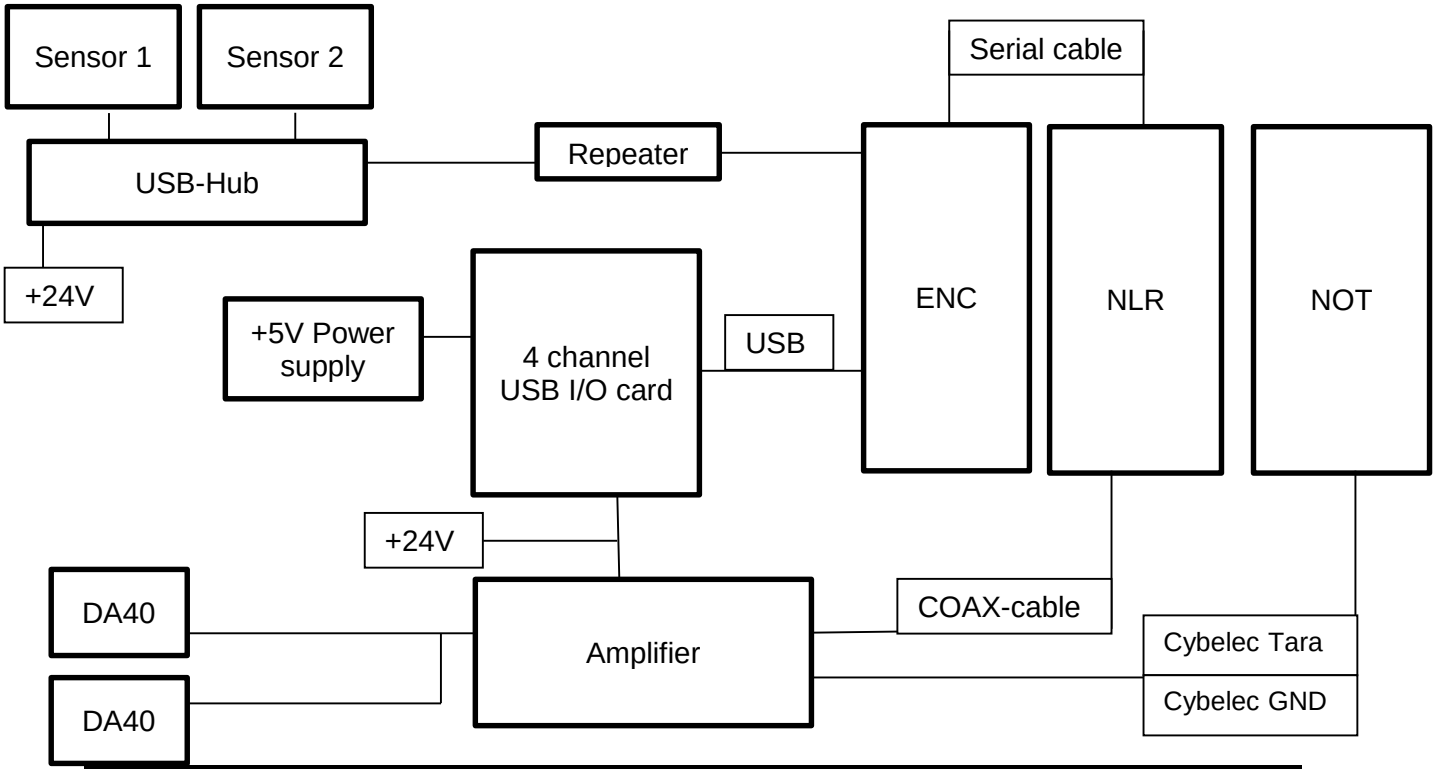
1.6.1. Hardware Connection to the Cybelec

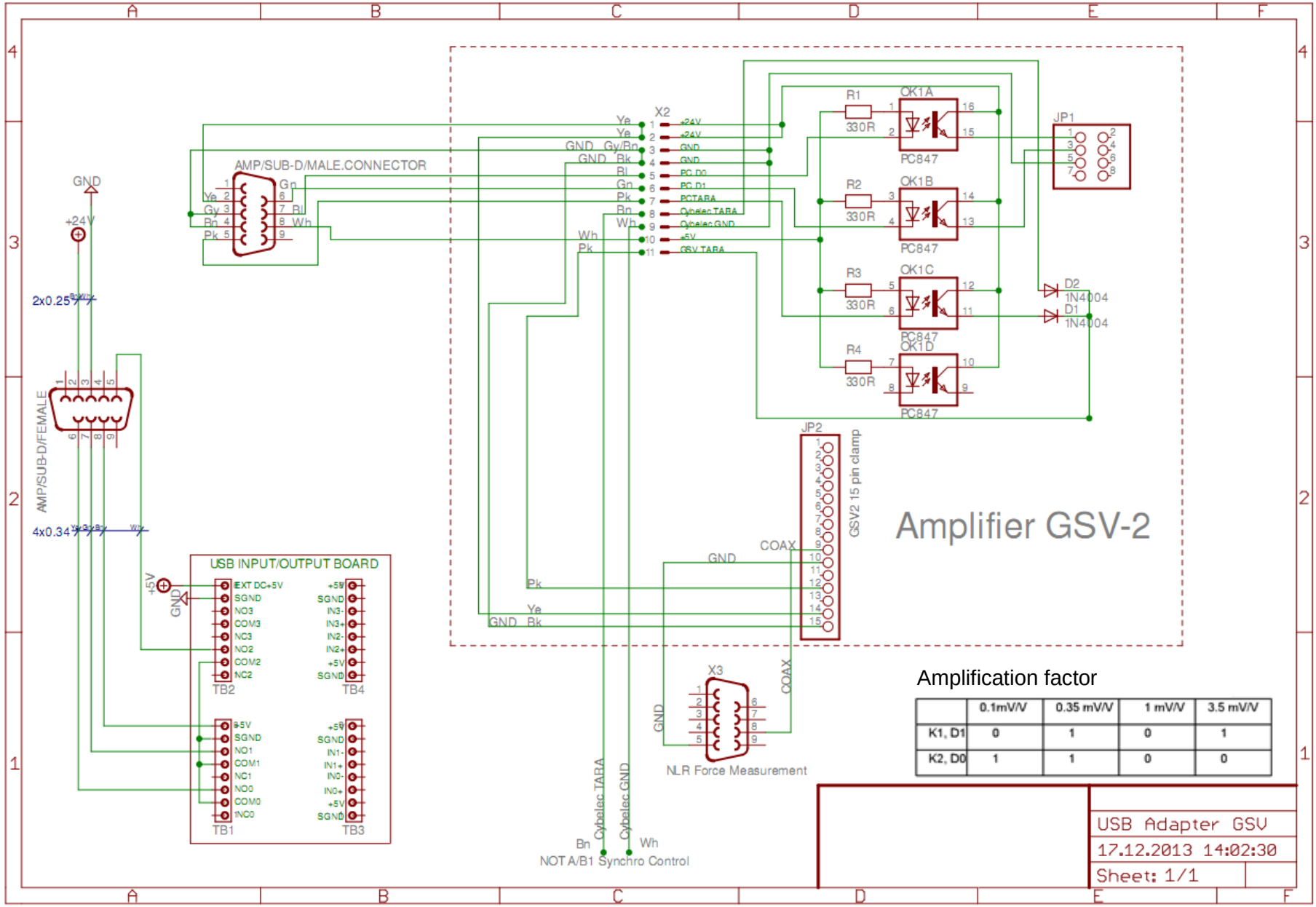
An NLR-Card must be installed in the Cybelec control.

If you use a LaserCheck computer you must connect everything according to this picture.
For the connection of the force amplifier see also **1.3.2 Wiring of the amplifier.**



If you use **LaserCheck without a computer** you must connect everything according to this picture.
For the connection of the force amplifier see also **1.3.2 Wiring of the amplifier or on the next page.**





	0.1mV/V	0.35 mV/V	1 mV/V	3.5 mV/V
K1, D1	0	1	0	1
K2, D0	1	1	0	0

1.6.2. Configuring the Cybelec-Software

In order to work with the data M LaserCheck, parameters must be set-up on the Cybelec control.

1. You need a Dongle to get the options Nr. 60 and/or 65
2. Go to Machine parameters -> **Options** page
   Change ´-´ into ´+´ for either angle measurement (Nr. 60) or angle measurement on both sides (Nr. 65)
3. Go to the **Welcome** page and enter -0607- into the service line (not for ModEva)
4. New parameter pages should be available for the **Angle measurement system 3**
5. Adjust parameters in DNC the same way it was done on the **Angle measurement system** page
6. Activate **angle measurement for individual bends** on **Correction - spring back**

A NLR-Card must be installed in the Cybelec-control.

The following figures should help you to configure a Cybelec control for the use with a LaserCheck angle measurement system.

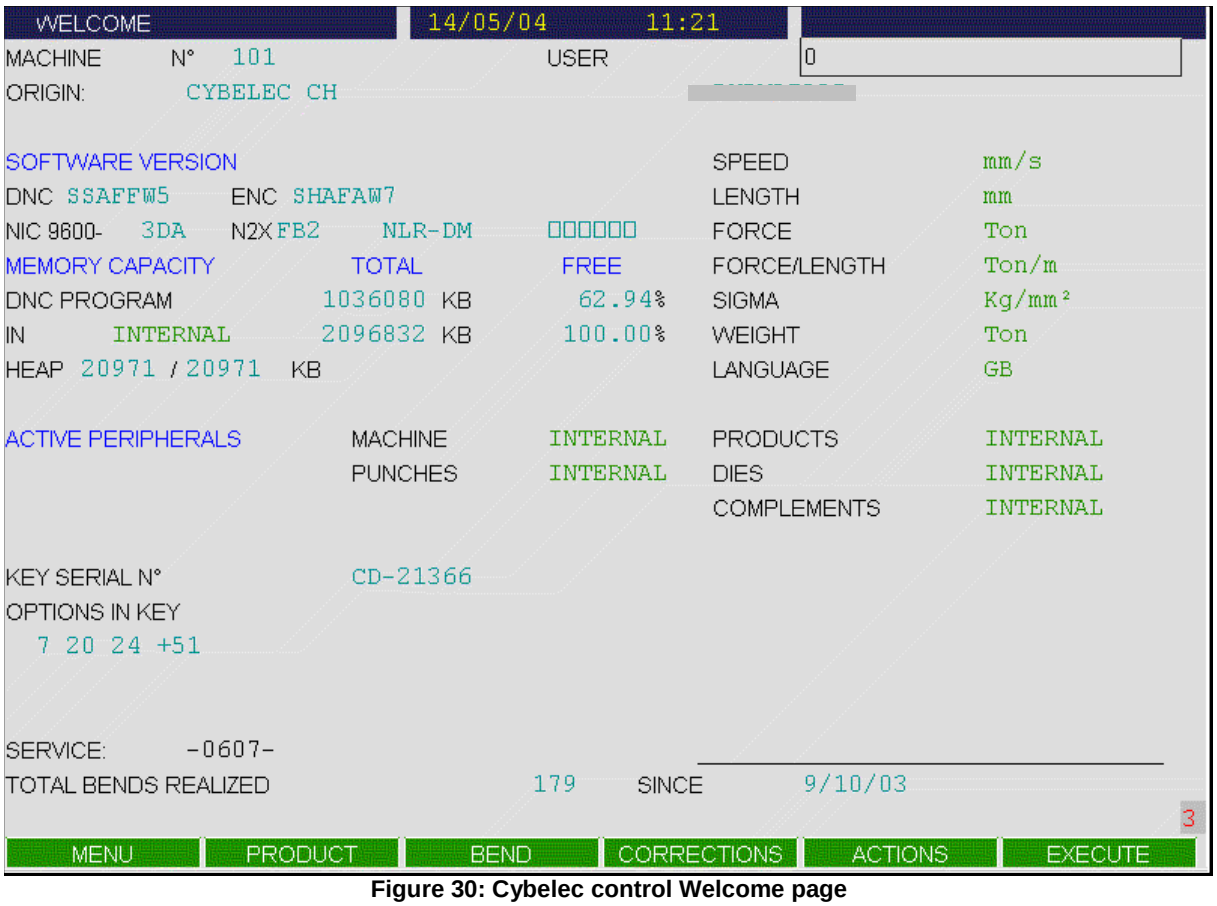


Figure 30: Cybelec control Welcome page

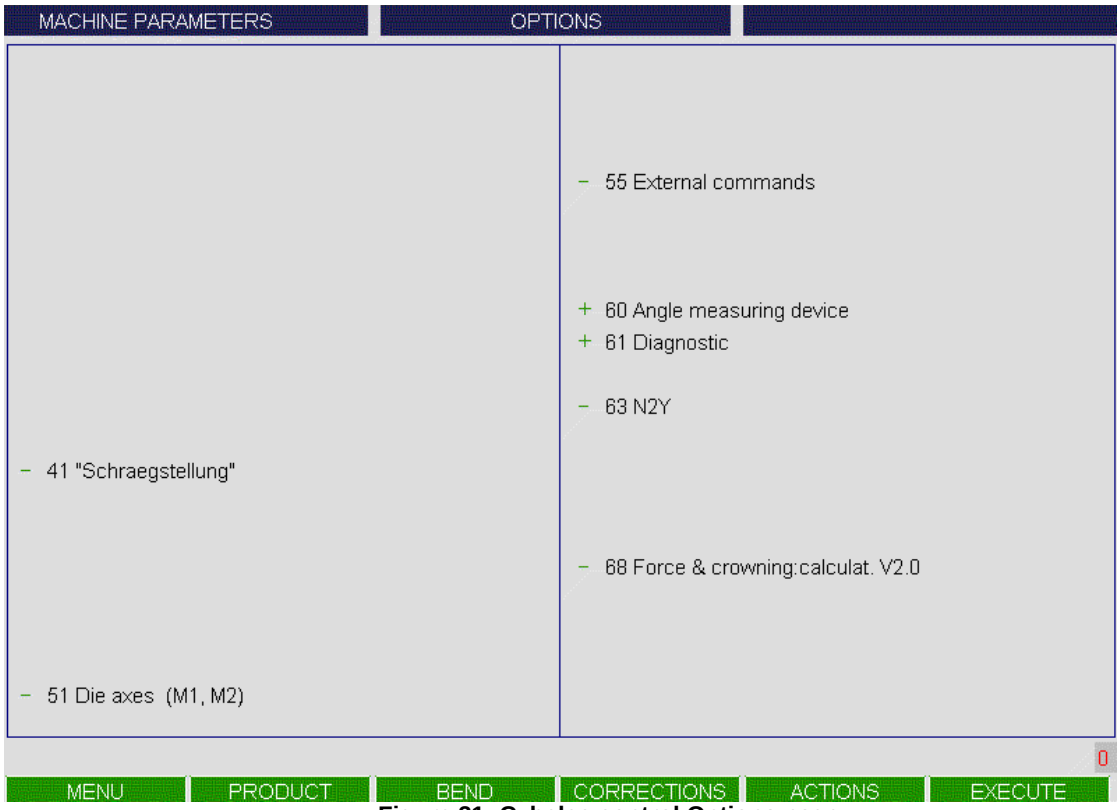


Figure 31: Cybelec control Options page

1.6.3. Connection with Cybelec

If you use a Cybelec-control, you have to adjust the control properly and then click on the Cybelec connection window, go to **Connection Cybelec/Settings** and choose the correct COM-Port (usually COM1).

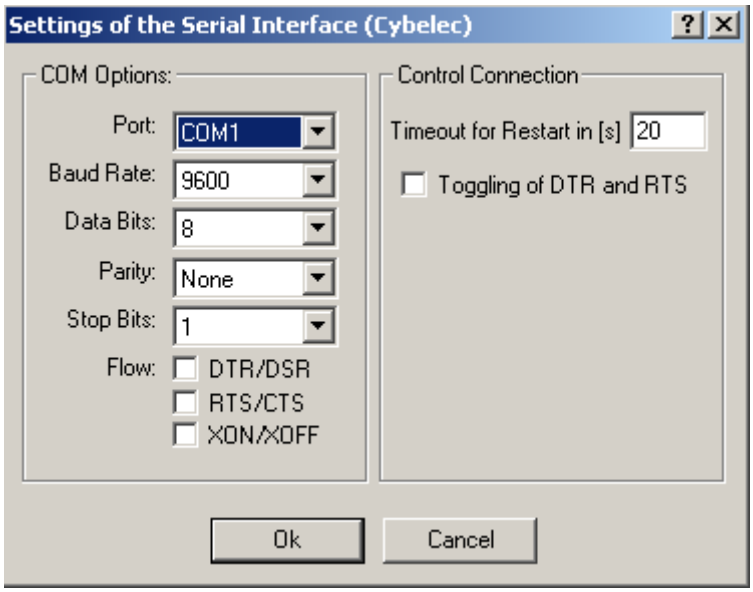


Figure 32: Serial connection interface settings

If you can´t establish a connection to the Cybelec-control, check the following:

1. Did you choose the correct COM-port?
2. Are all cables connected up properly?

1.6.4. Installing LaserCheck Software on ModEva 15

For LaserCheck 8, 9, 10 and TT, the LaserCheck software can be installed on the Cybelec PC. You will need 2 USB-ports to connect the sensors and one USB port for the interface to the GSV amplifier. LaserCheck 9 and LaserCheck 11 require a free GigE connector.
Install the uEye driver from the LaserCheck CD.
Then copy the folder data M Engineering onto the Cybelec hard drive.
Connect the USB-GSV interface and install the USB driver from the CD.
Connect the NLR-card to COM2 on the PC via a serial cable.
Start LaserCheck.exe.

1.6.5. Sensor Distance and Pressure Sensitivity Control with DNC

The sensor distance and pressure sensitivity control options use information sent from the ENC via the NLR card to the LaserCheck. The programmed pressure and the die width are used to adjust the strain gauge amplifier and the sensor positions respectively. Every time a mode change occurs or a new bending step is being loaded, these data points are transmitted.
In order to activate these options on the Cybelec-control, the following settings are necessary:

1. You need at least the Cybelec software DNC and ENC version **W**
2. Go to the Welcome page and enter–0607– into the maintenance line(not for ModEva)
3. Entries in Machine parameters **Angle measurement system page 3**
    a. Other Parameter (Reason -02-)
    b. File: D:\dataM.cyb
4. Copy the file datam.cyb to D:\

The contents of the datam.cyb file should be:

```
;V-Width, Material, Max. Pressure
#R502=
<502,,DEC>
#CR
#LF
;Material
#R28=
<28,,DEC>
#CR
#LF
;Max. Pressure
#R94=
<94,,DEC>
#CR#LF
```

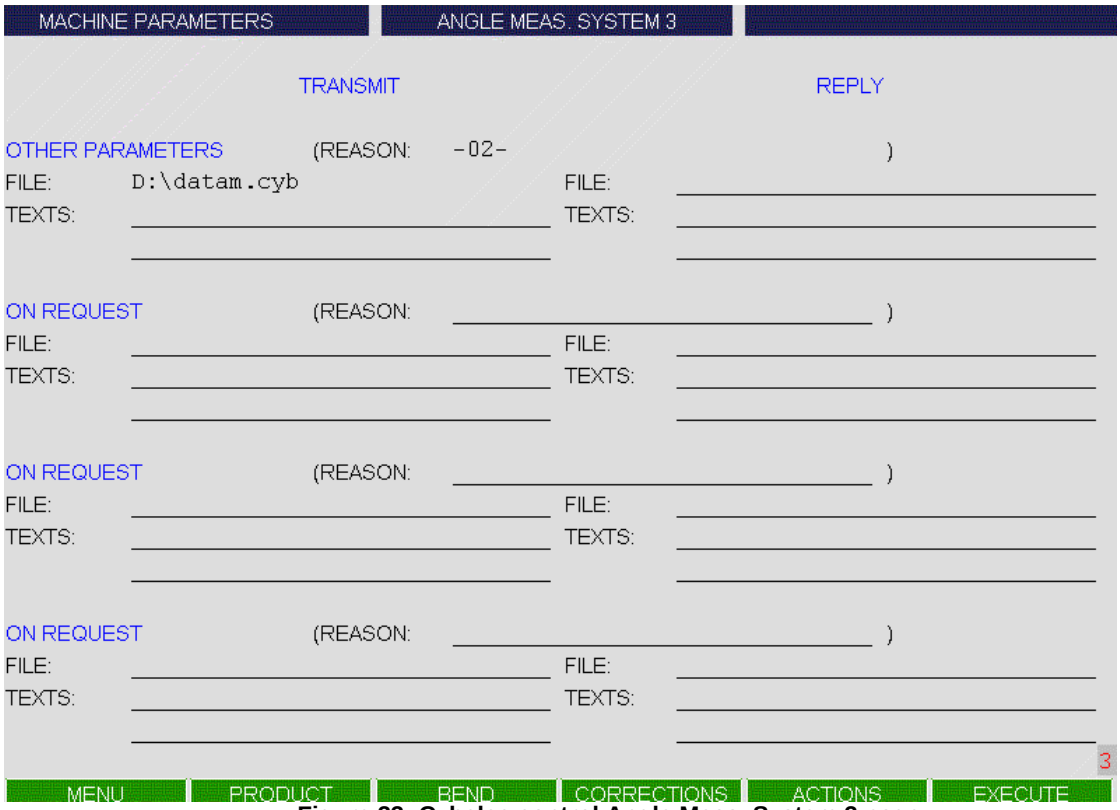


Figure 33: Cybelec control Angle Meas. System 3 page

1.6.6. Longitudinal Adjustment Control with DNC

The .cyb file must also contain the normal parameters but in **binary** code. This option must also be enabled in the LaserCheck parameter file **Parameter 84**.

```
;V-Width, Material, Max. Pressure
#R502=
<502,,BIN32>
#CR
#LF
;Material
#R28=
<28,,BIN32>
#CR
#LF
;Max. Pressure
#R94=
<94,,BIN32>
#CR#LF
```

In order to work with the data M LaserCheck, the .cyb file must contain additional parameters.

```
; Auxiliary Function F10 for positioning mode selection
#R111=
<111,,BIN32>
#CR
#LF
```

For the 2 sensor movement options

```
; Bending length
#R64=
<64,,BIN32>
#CR
#LF
```

or

```
; Z1 and Z2 back gauge position
#R88=
<88,,BIN32>
#CR
#LF
#R89=
<89,,BIN32>
#CR
#LF
```

For the individual movement of 4 sensors

```
; Z1 and Z2 back gauge position
#R88=
<88,,BIN32>
#CR
#LF
#R89=
<89,,BIN32>
#CR
#LF

; Sensor Z1 Position
#R2790=
<2790,,BIN32>
#CR
#LF
; Sensor Z1 Position
#R2791=
<2791,,BIN32>
#CR
#LF
```

1.6.7. Programming Machine Parameters

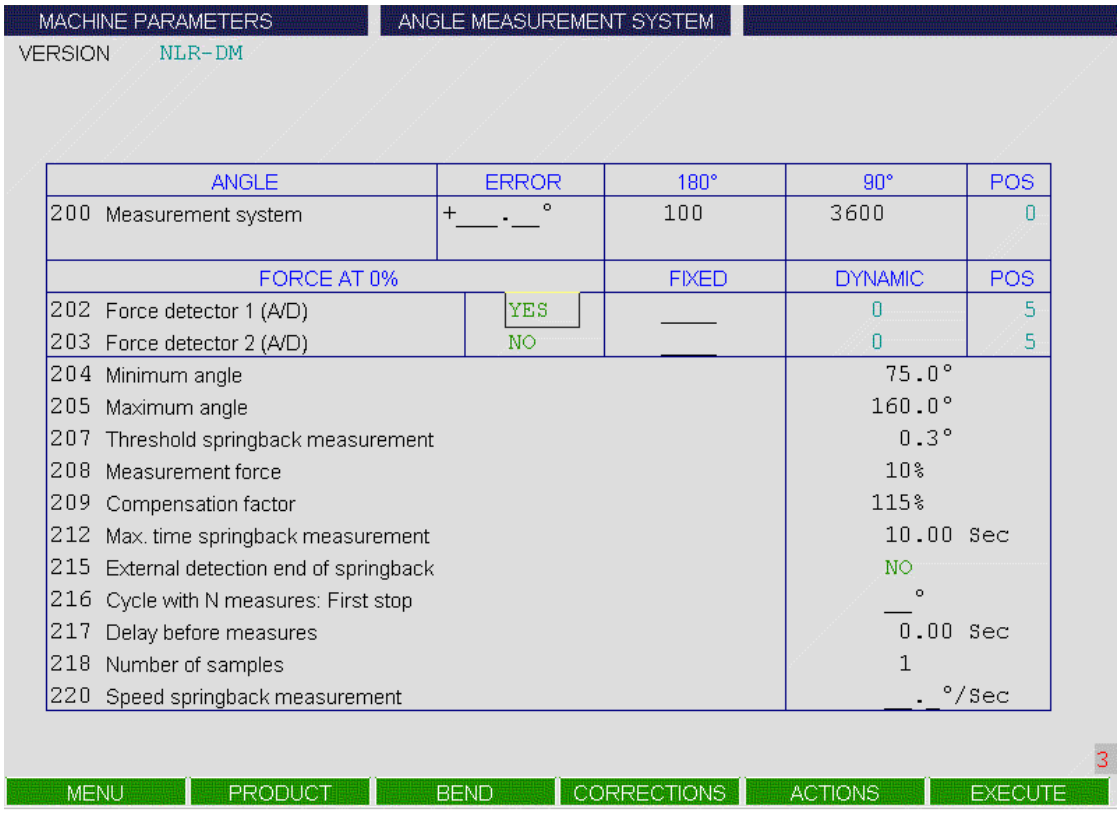


Figure 34: Cybelec control Angle Meas. System page

Unless the bending force of the current bend already requires a very large pressure, a bend including a spring back measurement procedure (SBMP) will be performed using the pressure specified by parameter **35c Min pressure if spring back measure**. If this parameter is left undefined, the value of parameter **33 Pressure** ↑ is used instead. The goal is to guarantee enough pressure to lift the beam during SBMP. Since a change in pressure at BDC might cause unwanted perturbations, this pressure is used throughout the entire bend, not only during SBMP lifting.

- Parameter 33 and 35C must be “high enough”. Begin with 100 %, and then diminish the value. Typical values range between 35% and 50%. Do not be afraid of overshooting.
- Input “**Permanent Regulation**”. Must remain at 1 throughout the entire cycle and it must not drop.

Other pertinent parameters can be found on the ANGLE MEASUREMENT SYSTEM parameters page. Values displayed at the bottom of the page form a reasonable starting point. They must however be adapted to the situation by hand. Each parameter will be described in more detail below.

200 Measurement System:

Error:
This value will always be added to the measured angle in degrees. If the sensor repeatedly displays systematic errors, these can be corrected by entering a value into the respective field. This correction can be overridden by programming a similar field on the SPRING BACK page, on a bend to bend basis.

180°, 90°:
Common values for these fields are **100 for 180° and 3600 for 90°.** These fields are used to build a simple linear function. In “90°”, enter the analogue value (value received from the corresponding serial line on the NLR) generated by the sensor when measuring an angle of 90°. In “180°”, enter the analogue sensor value representing 180° angles (which is typically not 0). These values will be used to build an interpolation table of 4096 entries (because analogue angle values are 12-bit values) with 12-bit values (because also transformed angle values are 12-bit values). Analogue values obtained from the sensors are transformed into angles by interpolation in the table. Analogue values below the value entered in field 180, will always give 180°. Care must be taken that there is no overflow for angles below 90°, i.e. values above 4096. Typically, we should have about 30 analogue values per degree.
POS:
This field displays the last analogue value obtained by the sensor.
202 Force detector 1 (A/D), 203 Force detector 2 (A/D):
YES/NO:
This selects wich force detector is used. Both can be used. If both are used, the software will use an average value. However, it will not be the average of the analogue ADC (Analog to Digital Converter) values, but the average of the “X% force” values.
MIN:
The minimum reliable force at BDC. When the forces are very small, it is difficult to obtain stable results. During the calculation of the total spring back, we also check the force measured at the BDC. If it is below a certain minimum threshold, it is considered unreliable. Moreover, we expect that the sheet would be released when the beam is raised. Therefore the difference of the measured angle matches the total spring back (i.e. we take the residual force as 0%).
FIXED:
This is the force sensor’s analogue ADC value when no force is applied (also known as “force offset” or “0% force value”). If a value is entered here, this offset can be seen as fixed and does not change with time. If no value is entered, then the system will try to determine this offset value at suitable points during the cycle. The value corresponding to the machine’s maximum force is not known and not necessary. However, care must be taken that the force sensor does not saturate when higher forces are in action.
DYNAMIC:
When automatically determined by the system (NLR), the force sensor’s ADC value corresponding to 0% force will be displayed here.
POS:
The current analogue value read from the force sensor’s ADC.
204: Angle: minimum..maximum:
The default values of these fields are 75° and 160°, respectively.
Angles outside of these values are considered unreliable.
207: Threshold spring back measurement:
The default value of this field is **0.3°.** (In degrees, transformed into mm as a function of nominal tools, thickness and target angle, when using step-wise approach). In order to linearize the measured values, the tension on the sheet is reduced with this value (e.g. when there is a strong stick-slip-effect). This parameter specifies how far the beam needs to be lifted off from the BDC before the 100% force and angle can be measured.
Use very little values, e.g. 0.0° to 0.3°.
208 Measurement force:
The default value of this field is **10%**. In one of the SBMP variants, the beam will be lifted until the force falls below a certain fraction of the 100% value measured at the BDC. At this point, the beam will stop and a new correct measurement will be taken (the X% value). This parameter specifies the default value for this stopping threshold. For every new bend, it can be overridden by entering a new value on the SPRING BACK page.
Programmed values above 65% will be taken as 65%.
Programmed values below 2% will be taken as 2%.

209 Compensation factor:
The default value of this field is **115%**. During SBMP, the software extrapolates the expected spring back angle. This parameter specifies how much must be compensated for this angle. A common value is 115%, but it is heavily dependent on the system, including in particular how “underestimating” the SBMP is.
212 Max time spring back measurement:
The default value of this field is **10s**. During SBMP, the beam is lifted until one of several conditions is met. However, this condition must be met within the given time, otherwise SBMP is aborted.
215 External detection of spring back.
The default value of this field is **NO**.This requires a special NLR version and external hardware. If programmed to YES, this parameter informs the NC that an external device exists which is able to detect the point where the sheet is released during the upward lifting of SBMP. In this case, a corresponding additional choice (BY MEAS. ANGLE AFTER EXTERNAL TRIGGER) is displayed, among others, in the selection list of the SPRING BACK CORR. field on the SPRING BACK page.
216 Cycle with N measurements: first stop.
The default value of this field is **5°**. (In degrees, transformed into mm as a function of nominal tools, thickness and target angle.) The purpose of this parameter is to determine the position of the first stop where the first angle measurement is taken.
216b Step size
The step size of this angle measurement cycle with stepwise approach can be modified. Usually, each intermediate step (except the last one) tries to cover half of the remaining distance to the target BDC. There are various ways of influencing these steps. The next step covers xx% of the remaining distance, e.g. each step covers 3/4 (75%) of the remaining distance.
217 Delay before measures
The default value of this field is **0.0s**, which is also the minimum value. It has proven useful to wait a little while after the beam has been stopped before asking the sensor for a new measurement. This allows the whole system to “settle”. Sometimes vibrations in the sheet or other parts of the machine can affect the reading. Waiting a little while can be the only way to overcome the problem, albeit introducing further delays. This parameter can also be adjusted in LaserCheck.
218 Number of samples
The default value of this field is **1**, which is also the minimum value. This parameter also applies to the step-wise approach. For the same reasons as explained for parameter 217 above, it is sometimes necessary to ask for several subsequent measurements and use their average value. This parameter specifies how many values are being read off. This parameter can also be adjusted in LaserCheck.
220 Speed spring back measurement
This speed will be converted into mm/sec as a function of BDC angle, thickness and tools. The beam will rise with this speed during the spring back measurement cycle, thus adapting to the bending conditions, especially to the die opening. This speed is limited to the maximum upward bending speed (parameter 13 on BEAM page).
222 Measurement dynamic offset
This machine parameter defines, whether the measurement of the force offset is done at TDC or at SP. The measurement at TDC is done at the beginning of each cycle when the ram is at TDC. The measurement at SP is done just after the ram passes the SP even if the downward motion is still active.

Remarks:

1. Measurement force (parameter 208 in machine parameters) should be changed according to the material used:
    - Alu =15-25%
    - Steel = 10-20 %
    - VA = 5-10%

2. In **Machine parameters** go to page **Angle measurement system**
   The value 3600 for 90° corresponds to a minimum angle (parameter 204) of 75°.
   However if you would like to use a different minimum angle, you must adapt the value for 90°.
3. You should also adapt the value for the speed of the spring back measurement (Parameter 220) according to thickness of the metal sheet.

1.6.8. General Installation Remarks

In order to ensure that **good conditions for using force sensors** are in place, you should consider the following.

- Install force sensors.
- Prepare an excel list to record readings.
- Program a typical task, with typical tools and typical metal sheets.
- Go to the page CORRECTIONS and look at the field SENSITIVITY. Record this value.
- Enter Semi-Automatic-Sensitive Mode (see Note 0).
- Do not put in a sheet.
- Press pedal and reach BDC. Keep the pedal pressed.
- Read force sensors and Y1, Y2 positions and record them.
- Press the + or ++ button. The upper beam should rise. Make sure that both Y1 and Y2 have moved up by the same amount and reached the same final position. If the beam does not rise, try to determine why. See Note 1.
  If possible, you could also install two comparators (dial gauges), one on the left and one on the right, to check for overshoots. See Note 2.
- Press the – or - - button. The upper beam should descend. Make sure that both Y1 and Y2 have moved down by the same amount and have reached the same final position. Also check for undershoots. See Note 3.
- Now, using the +,++,- and -- buttons, move the beam up and down in order to check the entire work space, between the pinch point and the lowest possible Y position.
  The force sensor's readings must remain constant all along. If you observe changes, they must be negligible compared to the expected readings during operation.
  If they are not negligible, it is crucial that you find a way to fix this problem, otherwise you will never be able to obtain stable results.

The main causes are:

- The centre of mass changes so much when the beam moves that the sensors can register it. This only happens with very heavy tools. Perhaps try to install the sensors elsewhere.
- Cylinders and pistons are possibly not well aligned and tension is created while in motion.

If the above has established that you can confidently work with your sensors, **check for linearity**.

- Install an angle measurement sensor or two, but do not connect them to the NC. Just make sure you can read off the angles.
- Repeat steps 1 to 5 from above, up to the activation of the SemiAuto-Sensitive mode.
- Put a sheet of suitable thickness in position, so that 1/4 of the max force is required
- Press pedal and reach BDC. Keep the pedal pressed.
- Read force sensors, angle(s) and Y1, Y2 positions and record them.
- Using the + button (not the ++), lift the beam. . Make sure Y1 and Y2 move smoothly and correctly, both reaching the same final position.

- At each step, read force, angle(s) and Y1 and Y2 positions and record them.
- When you release the sheet, stop and transfer the recorded data into an excel spreadsheet.
- Draw a scatter plot, with force on the abscissa and angle(s) on the ordinate.
- Draw a second scatter plot with Y1 and Y2 on the ordinate.
- Plots should reasonably resemble straight lines, thus validating the linearity of the relationship. See note 4.

o **Note 0:** In order to reach the SemiAuto-Sensitive mode, the machine must be in automatic mode. In addition to that, the inputs AUTOMATIC and REGULATION must be 0.
o **Note 1:** Typically, there is not enough pressure. Manually change the force value on the BEND NUM page. Then, report this value as a % of max force in parameter 35C on machine parameter page PRESSURE AND CROWNING. In some cases “Permanent Regulation” is the problem. This value must remain at 1 throughout the entire cycle. It must never drop to 0.
o **Note 2:** Very slight overshoots are acceptable if they are small compared to the SENSITIVITY. Otherwise you risk releasing the metal sheet during the spring back measurement cycle.
o **Note 3:** Undershoots should be as small as possible, in particular with small dies. Recall that this can be a major cause for faulty spring back: in fact, our current algorithms assume that BDC was reached without undershoot. Compare the amount of undershoot with the SENSITIVITY: if you have 0.01 mm undershoot (which is usually considered acceptable), you will have “lost” knowledge of about 0.01/0.0435= 0.2 degrees of elastic return. This is still acceptable, however higher values are not. A compensation factor (typically 115%) can help coping with this, but it is not adaptable to different situations: in fact, with small dies, the “lost” spring back is larger than with large dies.
o **Note 4:** This of course only holds for small angles. It is difficult to define “small”, because it depends on a number of things, including tool geometry, hence we just say 5-6 degrees. Note that the lines do not need to be linear throughout. It suffices that it is reasonably linear in the range of the expected variation of spring back, i.e. in the zone just before sheet release. In some cases, the amount of spring back is so large - say 12 degrees - so that we are outside the linear zone. In these cases, one must work with a manually predefined pre-compensation, in order to bring the work zone back inside the linear zone. E.g., if you are sure that spring back ranges between 10.5 and 13.5 degrees, you should enter a pre-compensation of – 10 degrees, in order to have the measurement done near the final BDC. If this range is also too large, there is currently no other solution than completing multiple cycles of spring back measurement and compensation.

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1.6.9. Programming Bends

The SPRING BACK page can be reached via the CORRECTION page, but also via BEND NUM, BEND 2D and BEND 3D. Full control over the use of the AMD and SBMP is possible from here, mainly on a bend to bend basis.

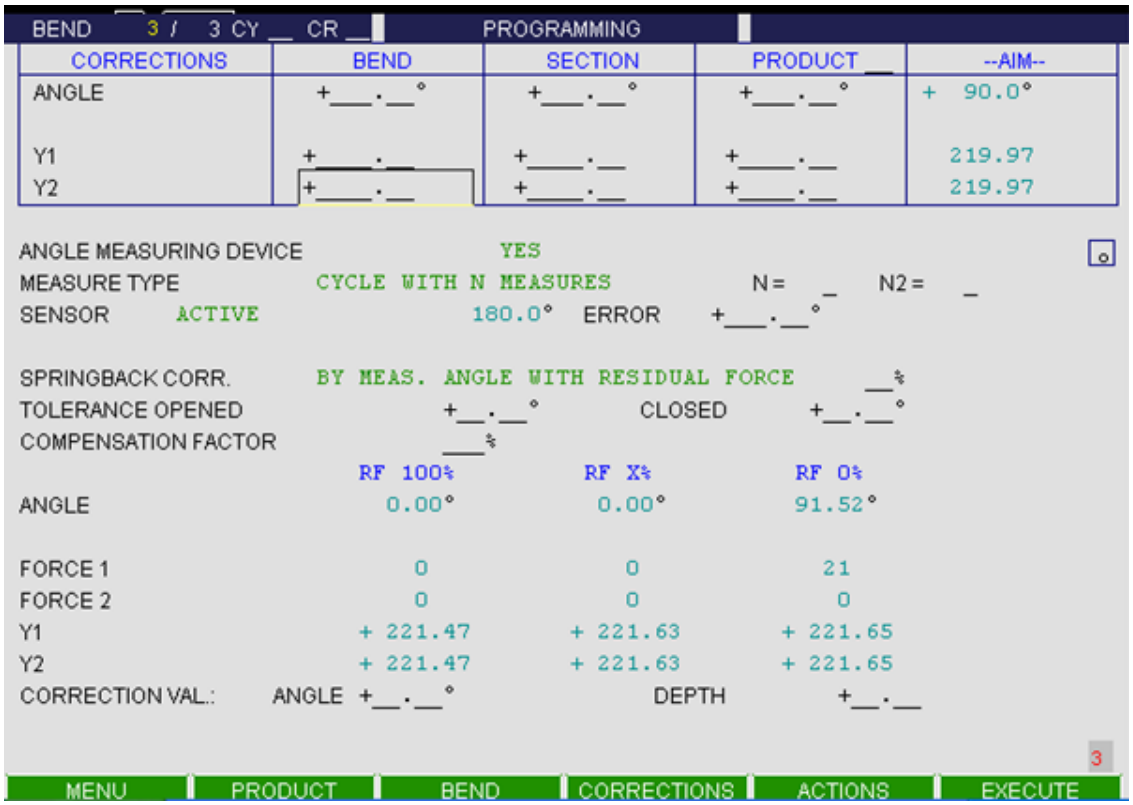

Figure 35: Cybelec control programming

ANGLE MEASURING DEVICE:
This is a general switch that specifies whether an AMD will be used. It should also be used to temporarily bend without using the device, in case of problems or unavailability.

MEASURE TYPE:
Here one can again select whether an AMD is in function and which method (type) is used to control beam motion. The option NO MEASURES (DEPTH) is always available. If option 60 is confirmed, choose CYCLE WITH N STEPS.

N:
This field specifies how many intermediate stops are performed before reaching the first BDC. The default value is 1 stop. If 0 is entered into this field, the NC will try to reach the first BDC with a single “blind” step. This is useful only if a SBMP is performed afterwards. In most cases, 2 or 3 intermediate stops give the best results.

N2:
This field specifies how many intermediate stops are performed during the compensatory upward motion to the second BDC and after SBMP. The default value is 0 (no stops). Better results are achieved with 1 or 2 stops. **N** and **N2** fields can be changed on each bend. However, usually, the same values are used for all bends.

SENSOR:
On each bend, the angle sensor can be either NON ACTIVE (off), ACTIVE or in AUTODETECTION mode. For sensors in AUTODETECTION MODE, the system will only accept angles between minimum and maximum values (parameter 204). Ultimately, however, the angle value must be between 1° and 179°.

ERROR:
This field can be used to correct systematic angle errors, probably caused by tools or other factors, but not by the sensor alone. The value entered into this field is added to the measured angle value before using it in any algorithm. This correction will override the one specified in parameter 200. For systematic errors stemming exclusively from the sensor, we recommend using parameter 200.

SPRING BACK CORR.:
When a SBMP variant has been selected in the SPRING BACK CORR. field of this bend, several other bend-related fields appear.

TOLERANCE OPENED/CLOSED:
During SBMP, the system estimates the final resulting angle assuming the sheet has been released. If the estimated final outcome is within the tolerances (desired angle + CLOSED and desired angle + OPENED) specified by these fields, no compensatory descent is performed at all, because the angle is considered acceptable. Instead, the beam is lifted to the TDC. This considerably shortens the overall bending cycle time. Moreover, if the estimated final outcome is already smaller than the lowest tolerance, there is no point in pursuing compensation, because the angle is already closed too far. Also in this case, the beam is lifted to the TDC, while an error message is displayed ("ANGLE!") OPENED and CLOSED values are added to the bend's desired angle, to obtain the tolerable limit values. Default values are +0.3 and –0.3°, respectively. We recall the possibility of using known pre-compensation values which need to be entered into the ANGLE row of the CORRECTIONS table at the top of the page, and are used for time-optimization purposes in controlled production settings.

COMPENSATION FACTOR:
This value overrides the default value (if any) specified by parameter 209. Special settings on the CORRECTION page allow the software to calculate a compensation factor, given practical results introduced by the operator. The procedure goes as follows:

1. On this bend, a full SMBP cycle must have been performed, with an initial tentative compensation factor (e.g. 100%) in Semi-Automatic mode, generating some angle and depth correction values.
2. On the CORRECTIONS page, in the table at the bottom of the page, there is a row labeled ANGLE. Enter the obtained, manually measured angles into the appropriate fields (e.g. under column BEND). This angle probably differs from the desired angle. The difference is called the "compensation error".
3. We can now see the new compensation factor on the SPRING BACK page. The new value has been calculated with the aim to reduce the compensation error to virtually 0. The underlying idea is that if the compensation error was positive (obtained angle too big), then the compensation factor was insufficient and must be increased. On the contrary, if the compensation error was negative (obtained angle too small), it was excessive and must be decreased.
4. The procedure can be reiterated, albeit a single trial usually suffices.

RF 100%, RF X%, RF0%:
Here RF stands for "(measured at) Residual Force". At the end of each SBMP, a set of useful values is displayed here. Column RF 100% displays the angle, forces (sensor 1 and 2) and beam position (Y1 and Y2) measured at BDC (or slightly above), before starting SBMP beam lifting. Column RF X% displays the same information as measured when SBMP beam lifting is stopped. Column RF 0% is different. Row ANGLE displays the estimated final outcome assuming the sheet has been released. Rows Y1 and Y2 display the estimated beam position, at which the sheet is released. Rows FORCE 1 and FORCE 2 display the current DYNAMIC force offset (i.e. sensor reading at zero force, see parameters 202 and 203). These values are also recorded in the LOG.

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1.6.10. Easy Use of Spring Back Measurement Pages

A degree symbol ° appears in the top right corner of BEND NUM, BEND 2D, BEND 3D and SPRING BACK pages. By clicking on it, a dialog window is displayed, whose purpose is to reach the SPRING BACK page quicker, without first displaying the CORRECTIONS page. This is achieved by simply clicking on **DISPLAY SPRING BACK PAGE**, at the bottom of the window. Also you can initialize SPRING BACK page fields for all bends following common, user-defined rules. This is achieved by first programming the various fields and then clicking on **INITIALIZE ACCORDING TO THESE PARAMETERS**. When appropriate, the operator can use the SPRING BACK page to further refine the programming. To simply quit the window with no other effect, click on **QUIT**.

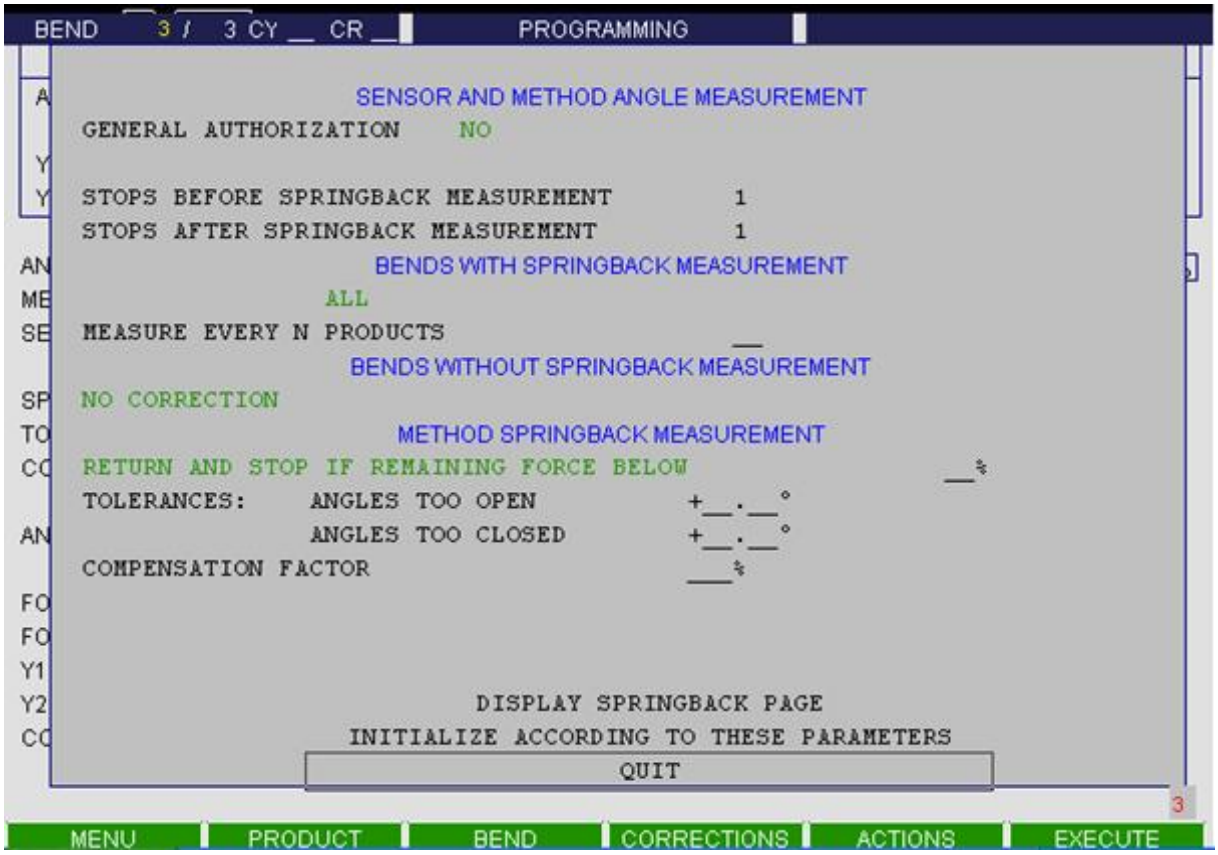


Figure 36: Cybelec control Sensor and Method Angle measurement

1.6.11. Bends with Spring Back Measuring Variants

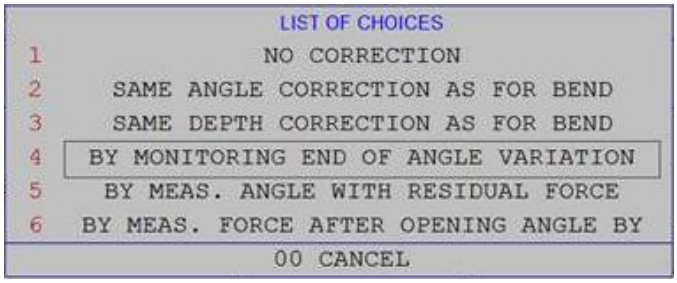

LIST OF CHOICES
1 NO CORRECTION
2 SAME ANGLE CORRECTION AS FOR BEND
3 SAME DEPTH CORRECTION AS FOR BEND
4 BY MONITORING END OF ANGLE VARIATION
5 BY MEAS. ANGLE WITH RESIDUAL FORCE
6 BY MEAS. FORCE AFTER OPENING ANGLE BY
00 CANCEL

Figure 37: Cybelec control bends with spring back measurement variants

NO CORRECTION

No SBMP will be performed.

The beam simply reaches the BDC target angle by using the angle sensor and then returns to the TDC. However, a user-defined correction can be introduced using the CORRECTIONS table at the top of the page. [Note that if the sensor is NOT ACTIVE, the BDC will be reached based exclusively on calculated (or programmed) Y axes values, without using the AMD.]

SAME ANGLE CORRECTION AS FOR BEND
This is the same as above, however, the target BDC angle is corrected in real-time using the CORRECTION VAL.: ANGLE obtained in a previous bend (reference bend) where a SBMP was active. When this choice is selected, an additional field appears on the right, where the user must enter the number (index) of the corresponding reference bend. The reference bend should show the same target angle and tooling as this bend, otherwise bad results have to be expected. A particular trick can be used to find all correction values at once and apply them subsequently for (quicker) production.

1. First, one of the SBMP variants is selected for a certain bend (say, bend 1), while other bends serve as reference bend.
2. Then, the product is bent in one go, generating some ANGLE and DEPTH correction values for bend 1.
3. Finally, the SPRING BACK CORR. field is switched to SAME ANGLE CORRECTION AS FOR BEND and the number 1 is entered as a reference bend (i.e. the bend now refers to itself).

The SBMP can now be switched on again in regular intervals, in order to look for material discrepancies.

SAME DEPTH CORRECTION AS FOR BEND
Similar to the above, except the obtained DEPTH correction is used instead of the ANGLE. No AMD is used. This option is interesting, because beam control using an AMD is usually slower than the familiar Y-based beam motion control. However, it has to be considered as less robust than the previous choice, as variations in the sheet characteristics cannot be taken into account. The same observations concerning the reference bend and related tricks apply, as with SAME ANGLE CORRECTION AS FOR BEND.

BY MONITORING END OF ANGLE VARIATION
This method of spring back requires real time measurement, but no force sensor is necessary. If the upper tool is lifted slowly at constant speed, the angle will initially open (increase) at a relatively high, constant rate, but subsequently, it will cease changing and will remain constant until the sheet is released. However, it is possible to detect a point where the sheet is almost, but not yet, released and to use this angle as an immediate estimation of the final outcome. In reality, a kind of gentle knee is formed. In this region, the angle only opens a little bit with a relatively large upward displacement of the beam. Hence, if the beam can be stopped here, the sheet is still held rather firmly, while the spring back angle has practically been completely “unrolled”. Our system detects this knee as follows: While the beam is being lifted, the current angle value is steadily compared with the one measured 0.3s earlier (parameter 211). As soon as the difference falls below approximately 0.1° (parameter 213), the lifting will be stopped.

The corresponding SBMP goes as follows:

1. At first, the BDC (or slightly above) angle is measured.
2. The beam is lifted and the angle is monitored until it ceases varying.
3. The beam is stopped and, at rest, the angle is measured again. This angle would have been considered the final outcome, had the beam been lifted until TDC.

Albeit being highly attractive, as it makes force sensors redundant, this procedure, by its proper nature, only offers the necessary robustness and reliability in very constant and optimal environments.

BY MEASURING ANGLE WITH RESIDUAL FORCE:
This choice is only available if at least one force sensor is present. This is by far the most commonly used model. When this choice is selected, an additional **%** field appears on the right. Threshold values entered here override the default value specified by parameter 208. Values, as low as 10-15%, are used in favorable situations. Recall that current usable limits are set to 2% - 65%. Values outside this range are taken as their nearest limit.

BY MEASURING FORCE AFTER OPENING ANGLE BY:
This choice is only available if at least one force sensor is present. When this choice is selected, an additional field appears on the right, where the operator can enter the angle value by which the beam is lifted before reading X% force and angle. The default value is 5°. This SBMP variant is more interesting when using CYCLE WITH N MEASURES, by which this value is transformed into mm, by a function of nominal tools, material and target angle. In fact, lifting the beam by a few mm can be quicker than monitoring the force sensor, because the NC can use its usual Y-based control algorithms, although usually less exact.
When a SBMP variant has been selected in the SPRING BACK CORR. field of this bend, several other bend-related fields appear.

1.6.12. Bends without Spring Back Measuring Variants

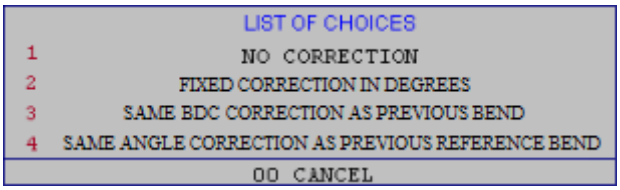

LIST OF CHOICES
1 NO CORRECTION
2 FIXED CORRECTION IN DEGREES
3 SAME BDC CORRECTION AS PREVIOUS BEND
4 SAME ANGLE CORRECTION AS PREVIOUS REFERENCE BEND
00 CANCEL

Figure 38: Cybelec control bends without spring back measurement variants

NO CORRECTIONS
For the remaining bends, no particular corrective action will be performed. The AMD will be used to approach the uncorrected nominal angle at BDC. However, it is expected that the user will modify the situation by entering special corrective values (pre-compensation values) on the SPRING BACK page.

FIXED CORRECTION IN DEGREES
When this option is selected, an additional field will appear on the right, where the user can enter the desired correction in degrees. The CORRECTION VAL. (ANGLE) field will initialize each bend with this value. The SPRING BACK CORR. field will be initialized together with SAME ANGLE CORRECTION AS FOR BEND. The bend itself is taken as the reference bend.

SAME BDC CORRECTION AS PREVIOUS REFERENCE BEND
The depth correction value of the corresponding reference bend will be reused. The SPRING BACK CORR. field will be initialized together with SAME DEPTH CORRECTION AS FOR BEND. For bends which are not compatible with the reference bend, NO CORRECTION will be displayed.

SAME ANGLE CORRECTION AS PREVIOUS REFERENCE BEND
The angle correction value of the corresponding reference bend will be reused. The SPRING BACK CORR. field will be initialized together with SAME ANGLE CORRECTION AS FOR BEND. For bends which are not compatible with the reference bend, NO CORRECTION will be displayed.

1.6.13. Spring Back Measurement Results

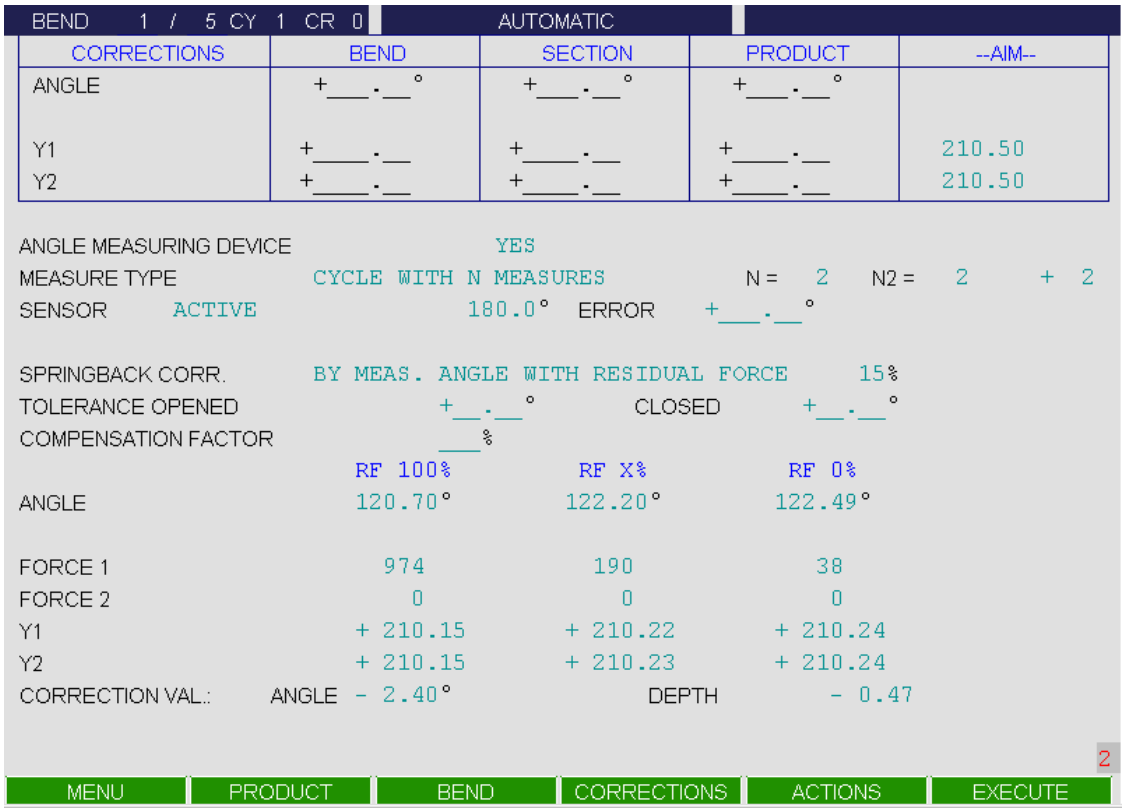


Figure 39: Cybelec control Automatic page

When SBMP is performed, it results in a correction value for the nominal BDC target angle. Both, angle and corresponding depth correction are obtained. These **CORRECTION VALUES** are displayed at the bottom of the page in the fields **ANGLE** and **DEPTH**. They are updated every time a new SBMP is performed on this bend. At the top of the page, a small **CORRECTIONS** table is displayed.

1.7. Tandem Option for Cybelec

1.7.1. General

The tandem option for LaserCheck allows running two press brakes with Cybelec controls in tandem mode with angle and spring back measurement. LaserCheck is synchronizing the sensor values of the two machines.
Compared to the standard system, there are the following differences:

1. The strain gauge amplifier for the force measurement are connected to the LaserCheck-computer, not the NLR-card. The LaserCheck-software reads the amplifier values, calculates an average value and sends the result to the NLR-card via an analog output.
2. Both LaserCheck-computers are connected via the network. The measurement results are exchanged via a Master/Slave-configuration.

1.7.2. Installation

Perform the following procedure:

1. Set up the separate LaserCheck systems mechanically and electrically at each machine.
2. Connect the amplifiers to the correct COM-port (COM2) at the LaserCheck-computers via serial interface.
3. Connect the LaserCheck-computers analog output to the NLR-card.
4. Connect the tandem switch to the TTL-input
5. Define Master and Slave machine in the parameter files.
6. Test the machines separately
7. Test the tandem mode.

1.7.3. Tandem Definitions

Master: Left machine with four connected sensors. On this machine the **server** configuration for the LaserCheck tandem option has to be installed. Set LaserCheck **parameter 92 to 2**.
Slave: Right machine with two connected sensors. This is the client configuration. Set LaserCheck **parameter 92 to 1**.
All z-coordinates start from the left side. They are counted independently for each machine. The z-positions are required for all sensors. The left sensors on the right machine (Slave) must be programmed to be at z = 0 position.

1.7.4. Mode of Operation

The tandem option synchronizes the angle measurements of two machines. All measured values are incorporated in the calculations to ensure that the upper dies are positioned on the same Y-value. In contrast to the standard application, this method also measures the bendingforces, synchronizes them and sends them to the NLR.
For the tandem option, 6 or 8 sensors are necessary. When using 6 sensors, the missing measurement values are calculated assuming that the two upper dies are at the same height. Therefore the positions of the two missing sensors need to be calculated and reported to Cybelec. When using 8 sensors, the tangential deviations of the upper dies are calculated separately. Besides the angle calculation it is also necessary to synchronize the sensor values. This can be achieved through coordinated answers from both LaserCheck-systems. This ensures that both controls get an angle at the same time. In order to get the average force, the amplifier are not connected to the analog input of the NLR as usual, but are read by LaserCheck via the GSVs serial output and are send to the NLR via an additional analog card after calculation.
Both machines can be operated separately when the tandem switch is deactivated.

1.7.5. Hardware

Two additional USB-DA14-cards will be needed in order to use the tandem option.

1.8. Wiring Schemes

1.8.1. Wiring Scheme for LaserCheck 6

The following wiring schemes only show the parts that can be repaired by the end user. Any other defects of the system will be dealt with by data M.
The connection of the USB cameras requires the following sequence:

USB Cameras -> Powered USB-Hub -> Small USB-Hub -> PC

Remarks:
Maximum cable length between Cameras and USB-Hub is 5m
Maximum cable length between two USB-Hubs is 5m
Maximum cable length between USB-Hub and PC is 5m

1.8.1.1. Stepping Motor Driver

The stepping motor driver is located inside the sensor housing. It controls the movement of the stepping motors and the status of the laser.
Note: Please carefully check the position of the JP1 connector. The mark "1" on the connector must match the "1" on the board!
Do not change the motor current with the potentiometer R7. It is adjusted to 1A/phase.
In case of malfunction replace L297, L298 and T1.

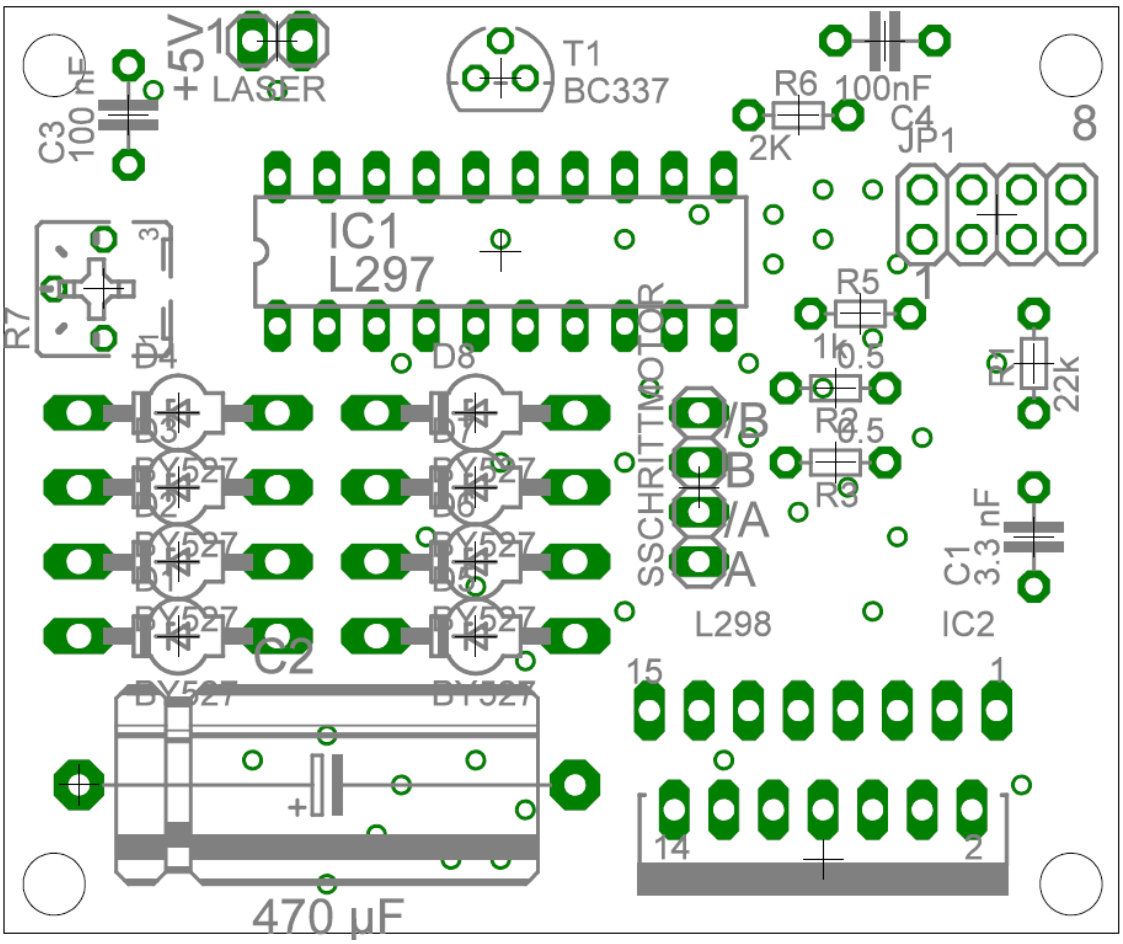


Figure 40: Stepping motor interface

Connection to LaserCheck computer (JP1):

Pin		Pin	
1	GND	5	Laser On/OFF
2	+24V	6	PWR GND
3	Motor Enable	7	Motor CW/CCW
4	+5V	8	Motor Clock

Table 7: Connection to computer (JP1)

1.8.1.2. Internal sensor interface

Inside the LaserCheck computer there is a sensor interface for the interaction between the parallel port of the computer and the stepping motor interface as well as with the amplification range settings of the GSV2. In case malfunction replace the drivers 74LS244.

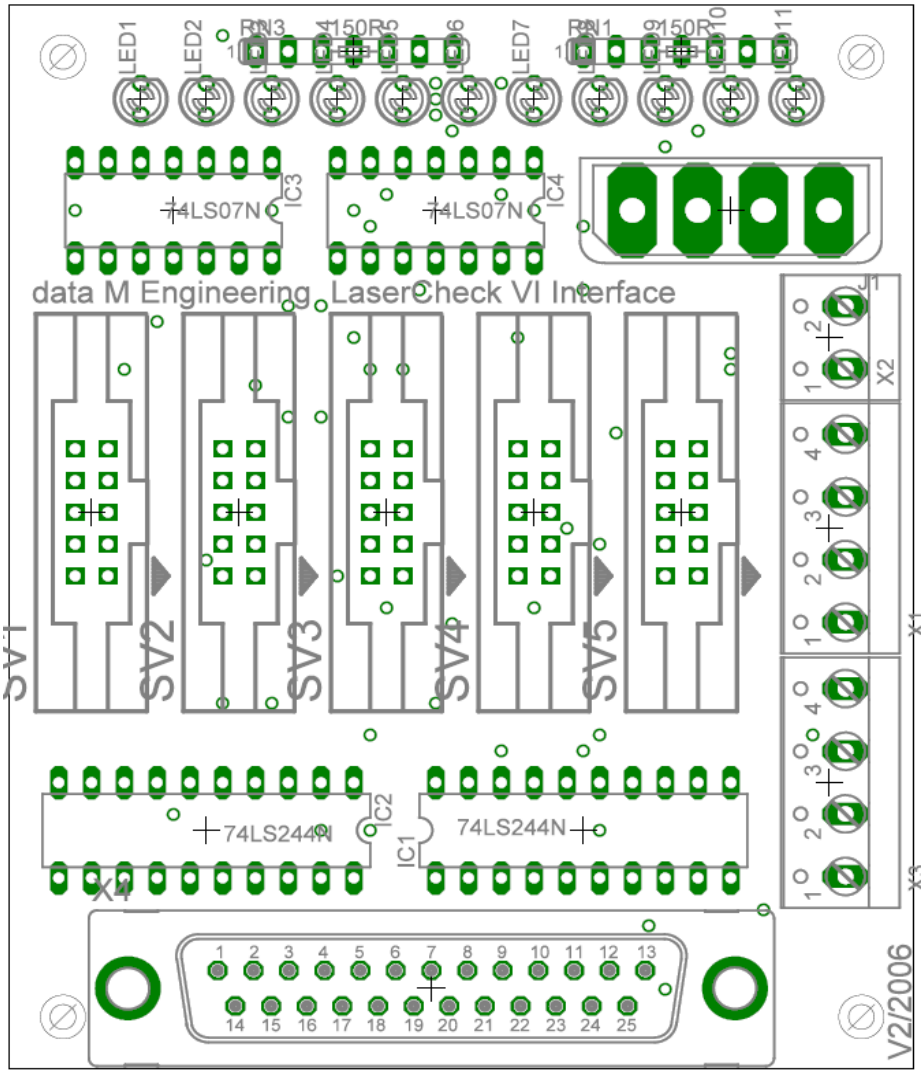


Figure 41: Internal sensor interface

Internal interface:
SV1 to SV5 are connected via a flat ribbon cable to the 9 Pin Sub-D connectors at the backside.

SV1	Sensor 1
SV2	Sensor 2
SV3	Sensor 3
SV4	Sensor 4
SV5	GSV

Table 8: Meaning of SV1-SV5

X1:

1	+24V Power supply
2	PWR GND
3	Ext. ATX PWR
4	Ext. ATX PWR

Table 9: Meaning of connector X1

The Ext. ATX PWR connectors are used to shut down the system via an external contact. Confirming this contact will shut down Windows.
Newer systems have a CF-Card with writing protection on C:\ and therefore do not need to be shut down.

X2:

1	ATX PWR
2	ATX PWR

Table 10: Meaning of connector X2

X3:

1	Input 0		SELECT
2	Input 1		PAPER OUT
3	Input 2		BUSY
4	Input 3		/ACK

Table 11: Meaning of connector X3

1.8.1.3. Connector pin assignment

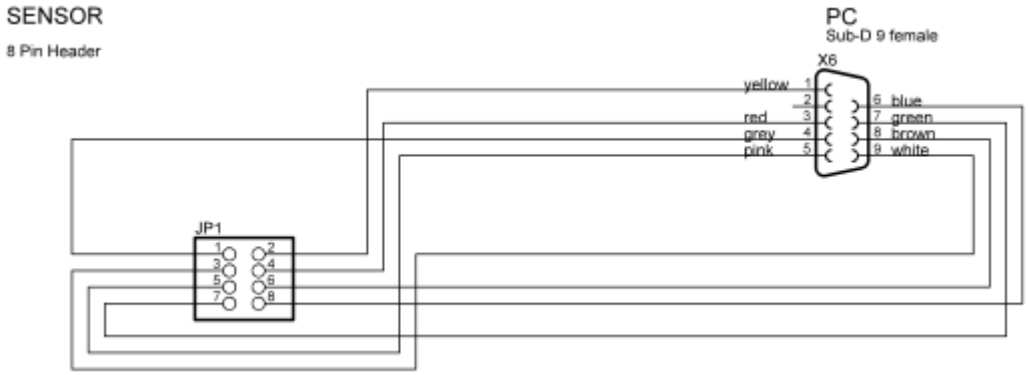


Figure 42: Connection cable sensor – PC

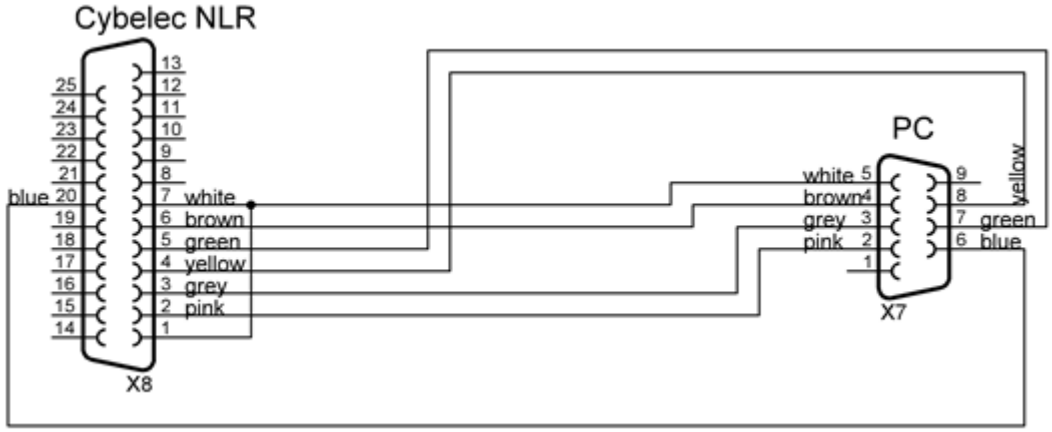


Figure 43: Connection cable NLR card – PC COM1

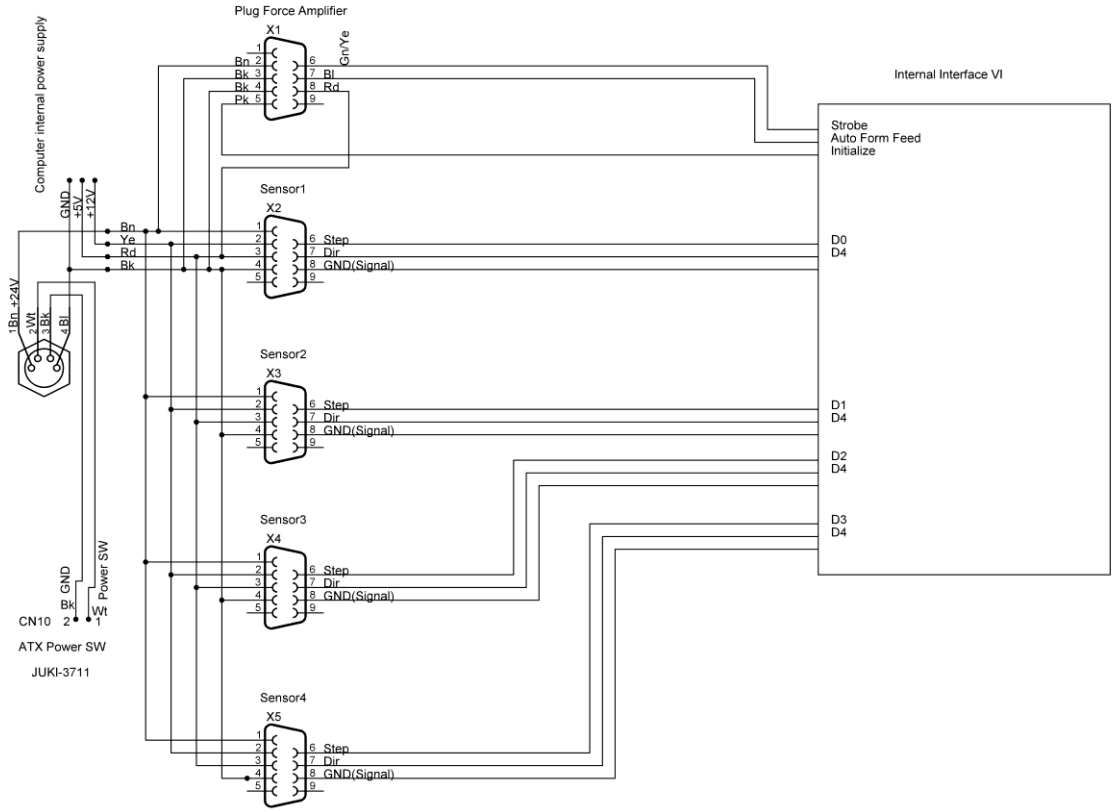


Figure 44: Wiring of the control computer

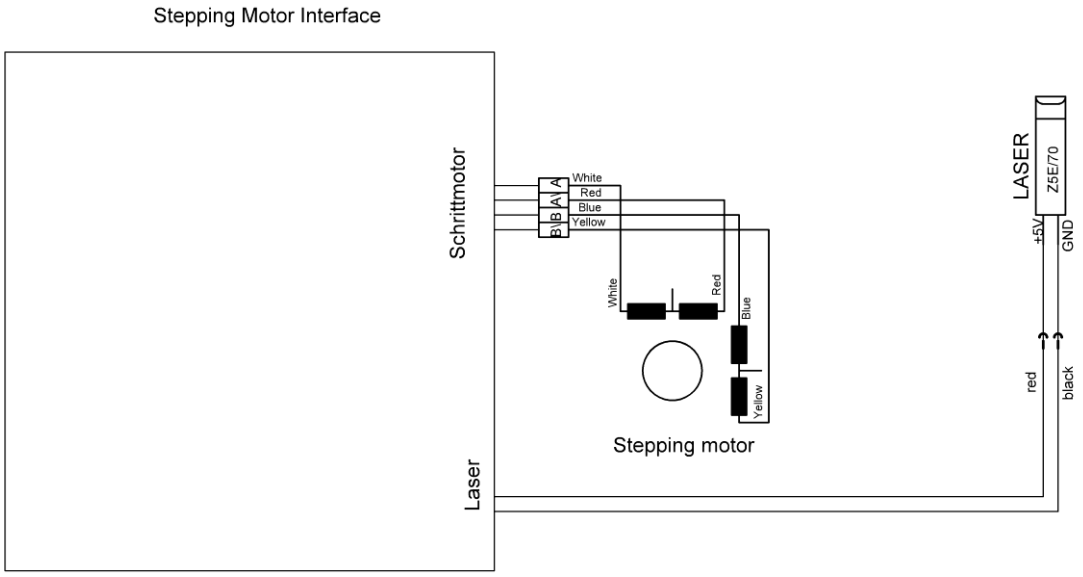
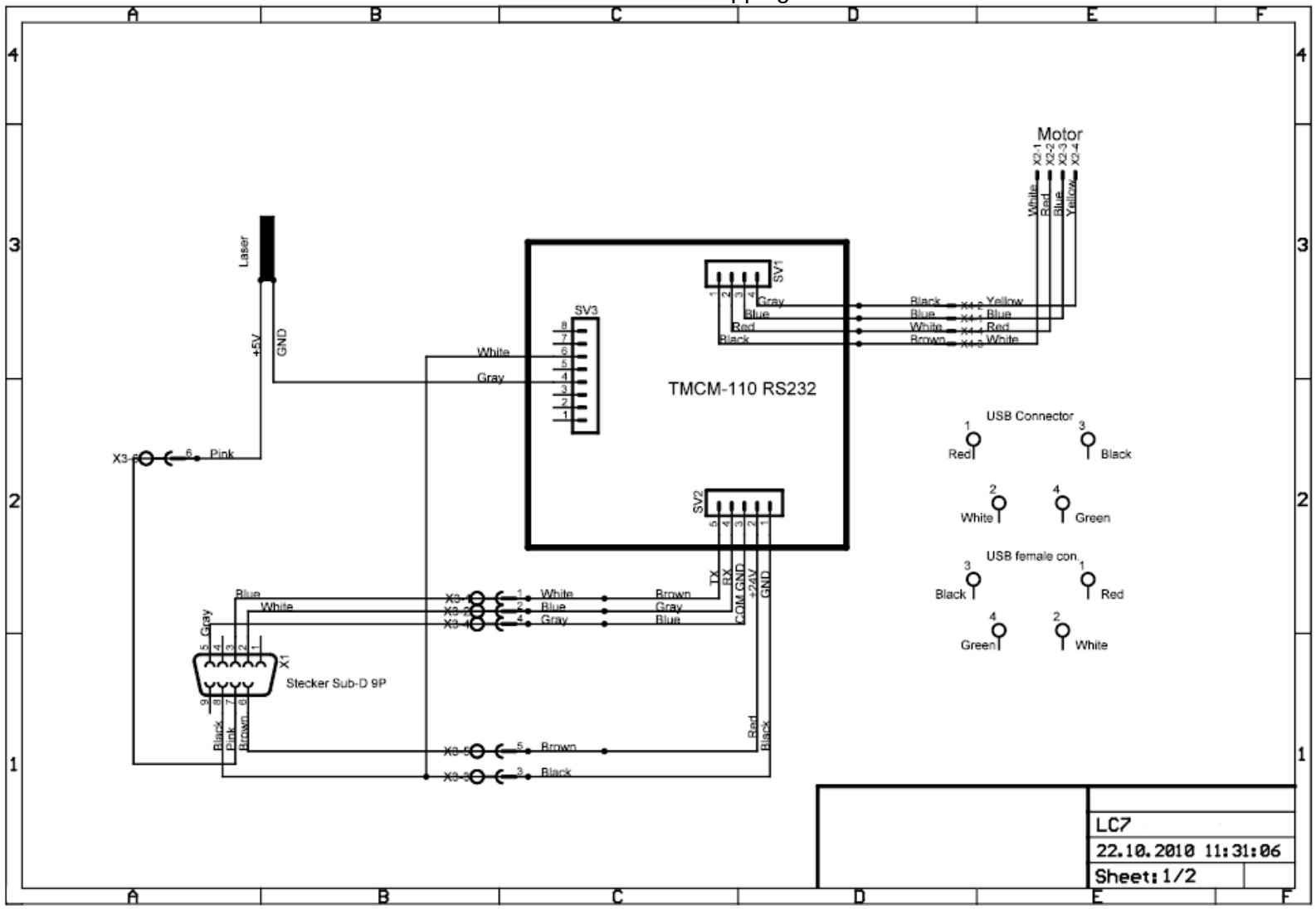


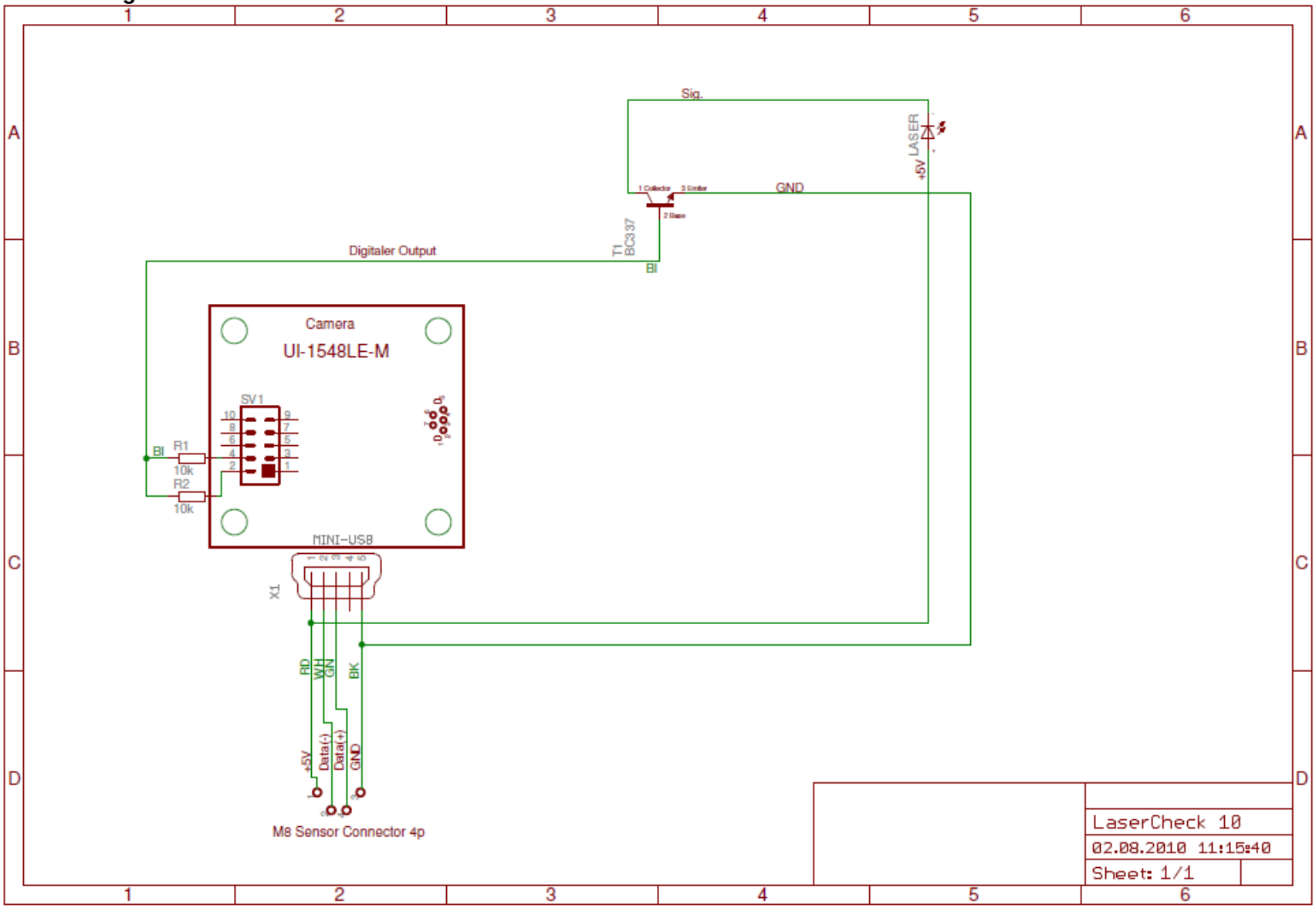
Figure 45: Wiring of the sensor

1.8.2. Wiring Scheme for LaserCheck 7

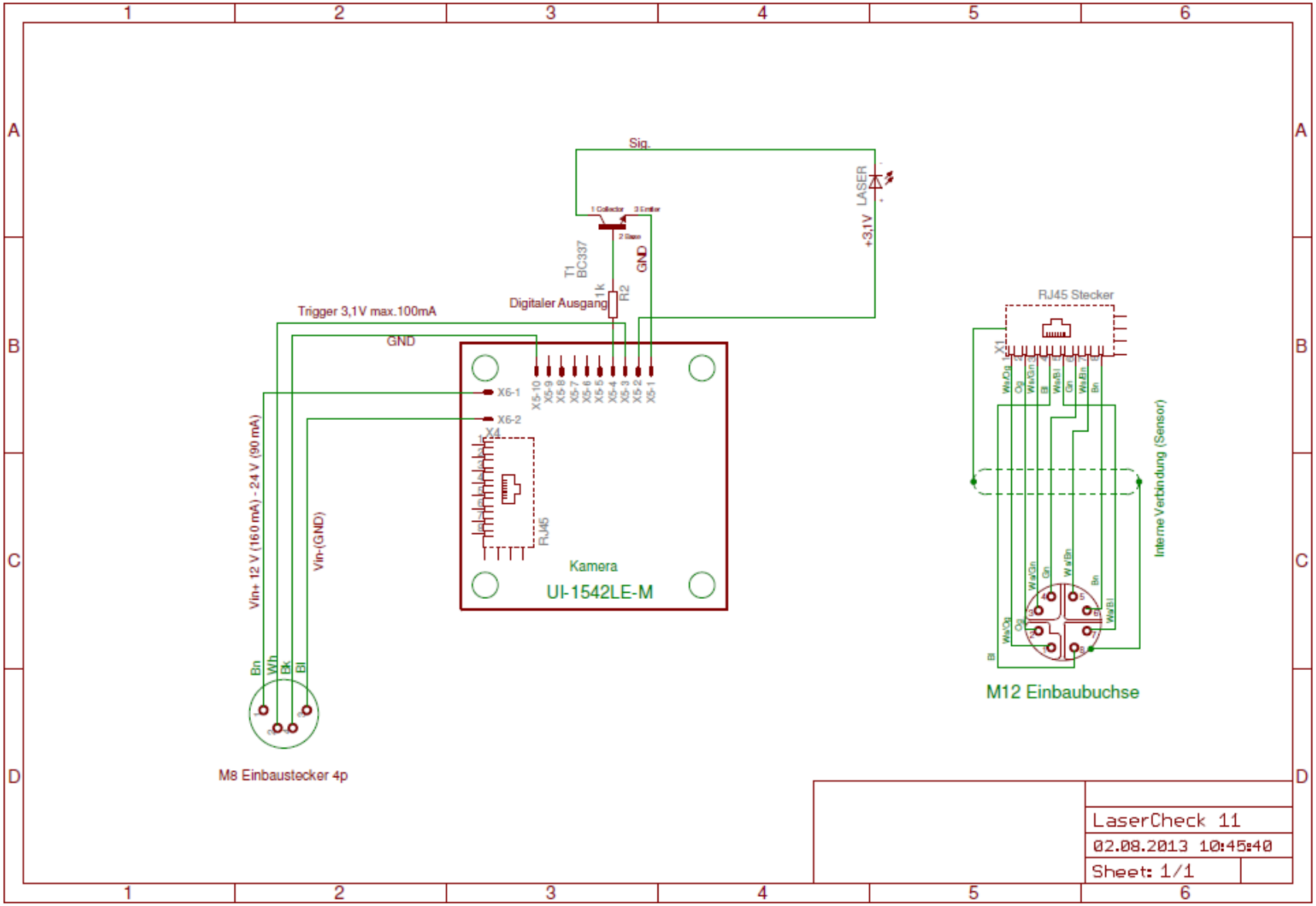
There is a module on the inside of the sensor which controls the stepping motor.



1.8.3. Wiring Scheme for LaserCheck 10



1.8.4. Wiring Scheme for LaserCheck 11



2. LaserCheck Software

By default, the LaserCheck computer is set up in such a way that the measurement program starts automatically as soon as the LaserCheck computer is powered up and the power switch is on. The computer can run without mouse, keyboard or monitor. However, it could be necessary that a mouse, a keyboard as well as a monitor must be attached for adjusting the measuring device. In that case the following screen should appear:

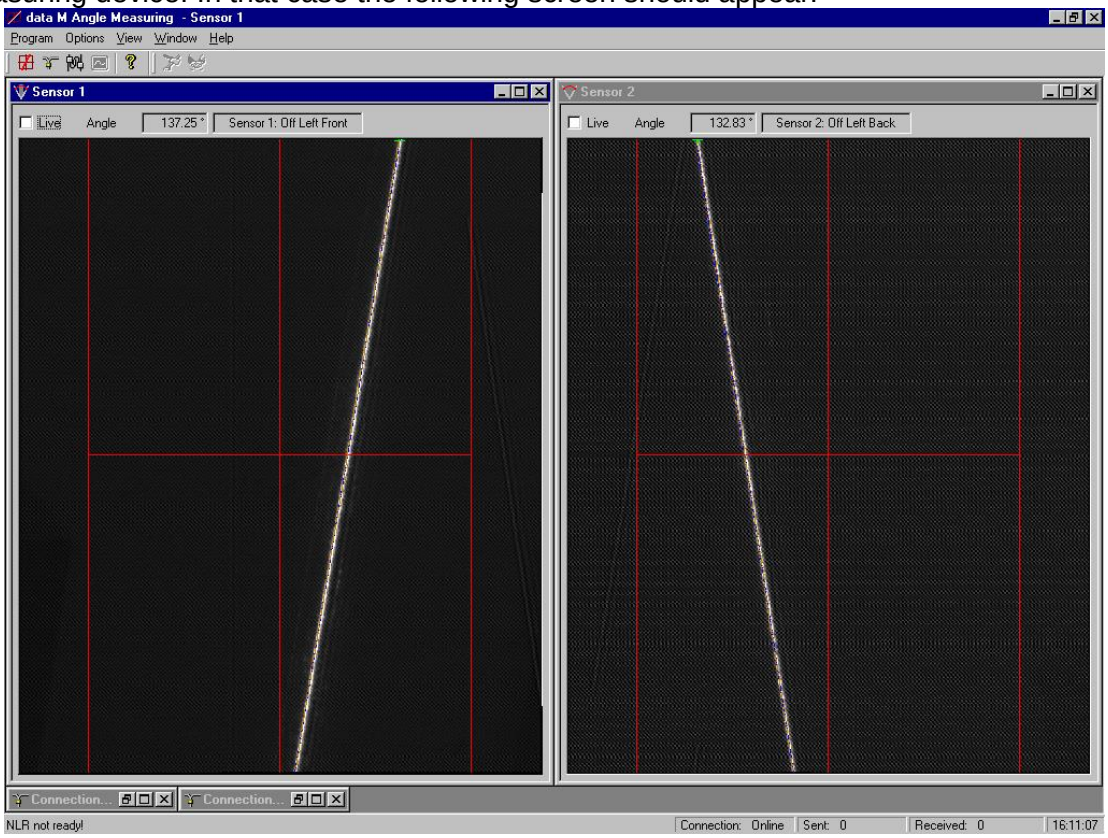


Figure 46: Control window of the LaserCheck program

2.1. License

If you only have a temporary license, you will see the following dialog pop up during the start of the program indicating the number of days remaining.

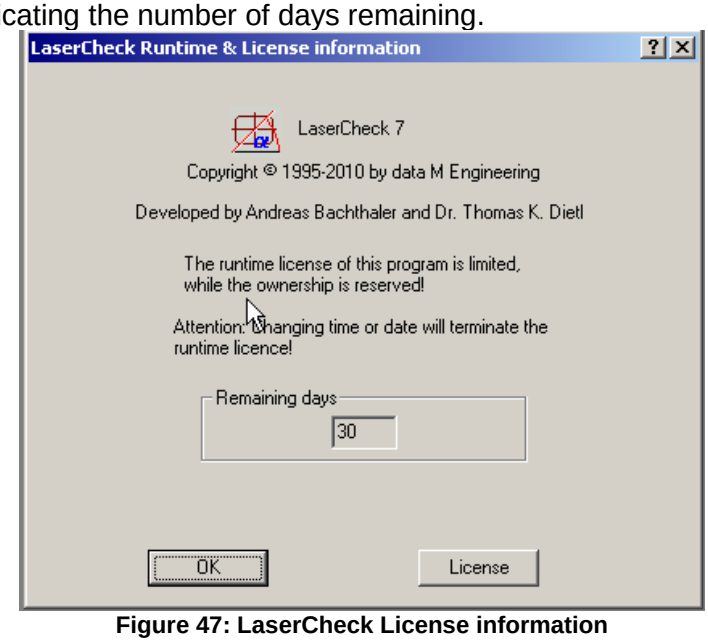

LaserCheck Runtime & License information
LaserCheck 7
Copyright © 1995-2010 by data M Engineering
Developed by Andreas Bachthaler and Dr. Thomas K. Dietl
The runtime license of this program is limited,
while the ownership is reserved!
Attention: Changing time or date will terminate the
runtime licence!
Remaining days
30
OK
License

Figure 47: LaserCheck License information

If your license has expired or if you do not have a license yet, the program will not start. You will need to obtain a new license. First press the **License** button, then the following dialog will open, where you can read your individual **program key.** By indicating this key you can obtain a new **License code** from data M. A temporary license expires if you change date and time by more than two hours.

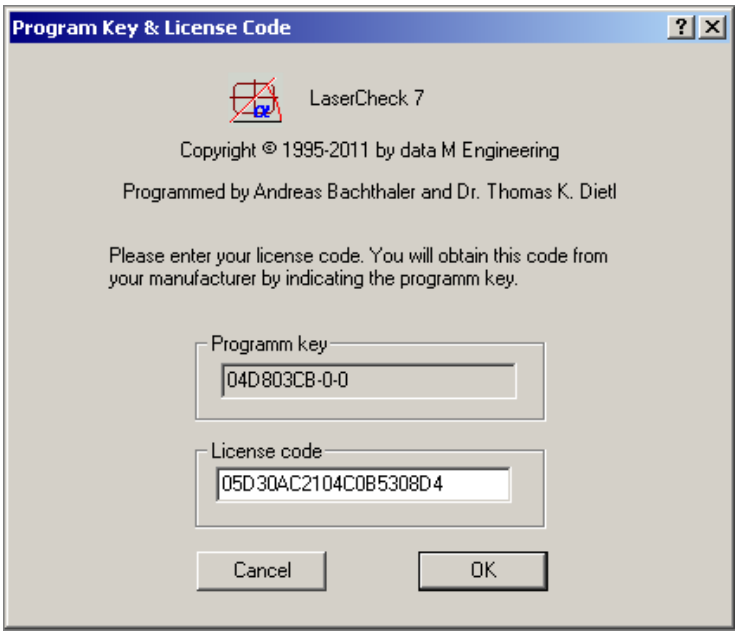

Program Key & License Code
LaserCheck 7
Copyright © 1995-2011 by data M Engineering
Programmed by Andreas Bachthaler and Dr. Thomas K. Dietl
Please enter your license code. You will obtain this code from your manufacturer by indicating the programm key.
Programm key
04D803CB-0-0
License code
05D30AC2104C0B5308D4
Cancel
OK

Figure 48: LaserCheck Program Key and License Code dialog

In Windows XP Embedded, the program will request you to restart the computer after you have entered an unlimited license code. Afterwards the automatic writing protection is activated on the CF-card. The license code is saved to the registry and uses a network-adapter's MAC-address as a key. Starting with Software Version 4.5 licensing the cameras is supported, too. Go to **Options/General Settings** and activate the camera as the license-type:

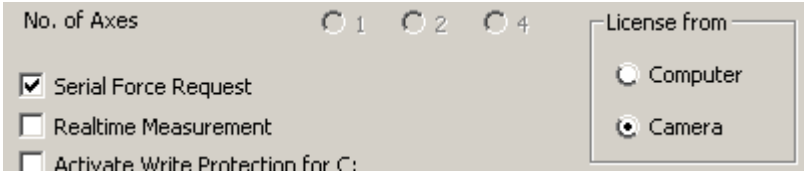


Figure 49: Choosing where to get the license from

Using this option, you can start the software from any computer, if a camera with valid license is connected. Every camera needs an extra license.

2.2. Program Start

Only for LC6 and LC7:
During the program start the connected sensors are referenced, i.e. moved to their back stops. No program input is possible during sensor movement. This position defines the physical zero position. Then the sensors are moved away from the machine again. This position is defined during calibration.

As the program starts, several background processes are started, that enable

1. the connection with the Delem control, and
2. the connection with the data M calibration computer LCAdjust.

Three different window types (document types) appear after the program start:

1. Sensor windows
   2 or 4 depending on the number of connected sensors. If a sensor is not working correctly, the corresponding sensor picture will not be opened. (Error check)
2. Connection window: Press brake UDP connection window or Cybelec connection
3. Connection window: LCAdjust

2.3. Program Options

The two connection windows are minimized, only their main bars are visible in the lower left corner of the screen.

Figure 50: Minimized windows of LaserCheck program

Individual menus are assigned to each window type. If a window is closed and it should be opened again, the following toolbar is available:

Figure 51: Toolbar of LaserCheck Program

A mouse-click on the first icon opens the following dialog in which the desired sensor image can be opened

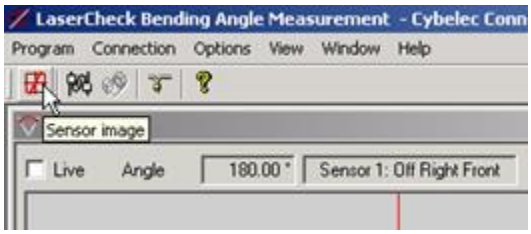

LaserCheck Bending Angle Measurement - Cybelec Conn
Program Connection Options View Window Help
Sensor image
Live Angle 180.00 ° Sensor 1: Off Right Front

Figure 52: Toolbar of LaserCheck program with sensor image icon

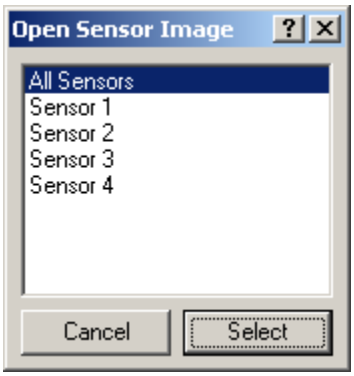


Figure 53: Sensor Selection dialog box

If the camera diagnostic module determines an error during the opening of the sensor, the appropriate window is not opened. In this case, check the connection of the sensor with the LaserCheck computer.

With the help of the next icon the *calibration connection window* is opened. If this window is not opened, no LCAdjust computer can be connected (via the TCP/IP interface).

Figure 54: Toolbar with calibration connection (LCAdjust) icon

The third icon opens the Press brake connection window or the Cybelec connection window. If this window is not opened, no connection with the bending press control can be established (via the serial interface) and consequently no bend can be performed using the angle measurement system.

Figure 55: Toolbar with control connection (Press brake connection) icon

Figure 46 shows camera pictures of 2 sensors. The red rectangles indicate the maximum search area (AOI), within which the laser line is searched by the software. Above every sensor image you find its corresponding status line:

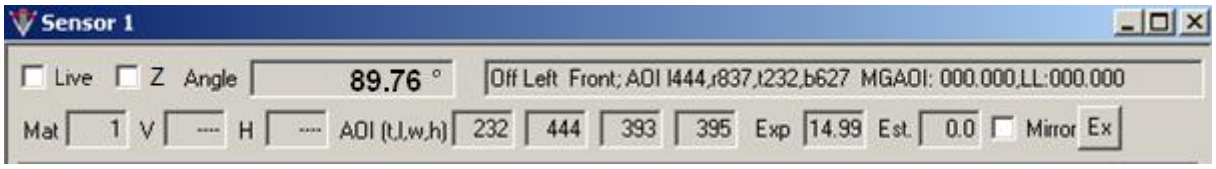


Figure 56: Status line of sensor 1

On the left, there is a check box with the title **Live** which activates the live picture mode. In this mode, the angle is permanently measured without transfer to the control. The current laser angle measured by the sensor is displayed in the *Angle* field. **A value of 180° signifies an error!** In the next field you can find the assigned position of the corresponding sensor. Also the current activation status (On/Off) is displayed. Next to it you can read the measurements of the AOI. On the bottom left you can see the number of the current matrix with its width and height. On the right you can see the **Mirror** option. **When using LaserCheck 10 or 11, you have to activate this option for sensors 2 and 4.**

Remarks:

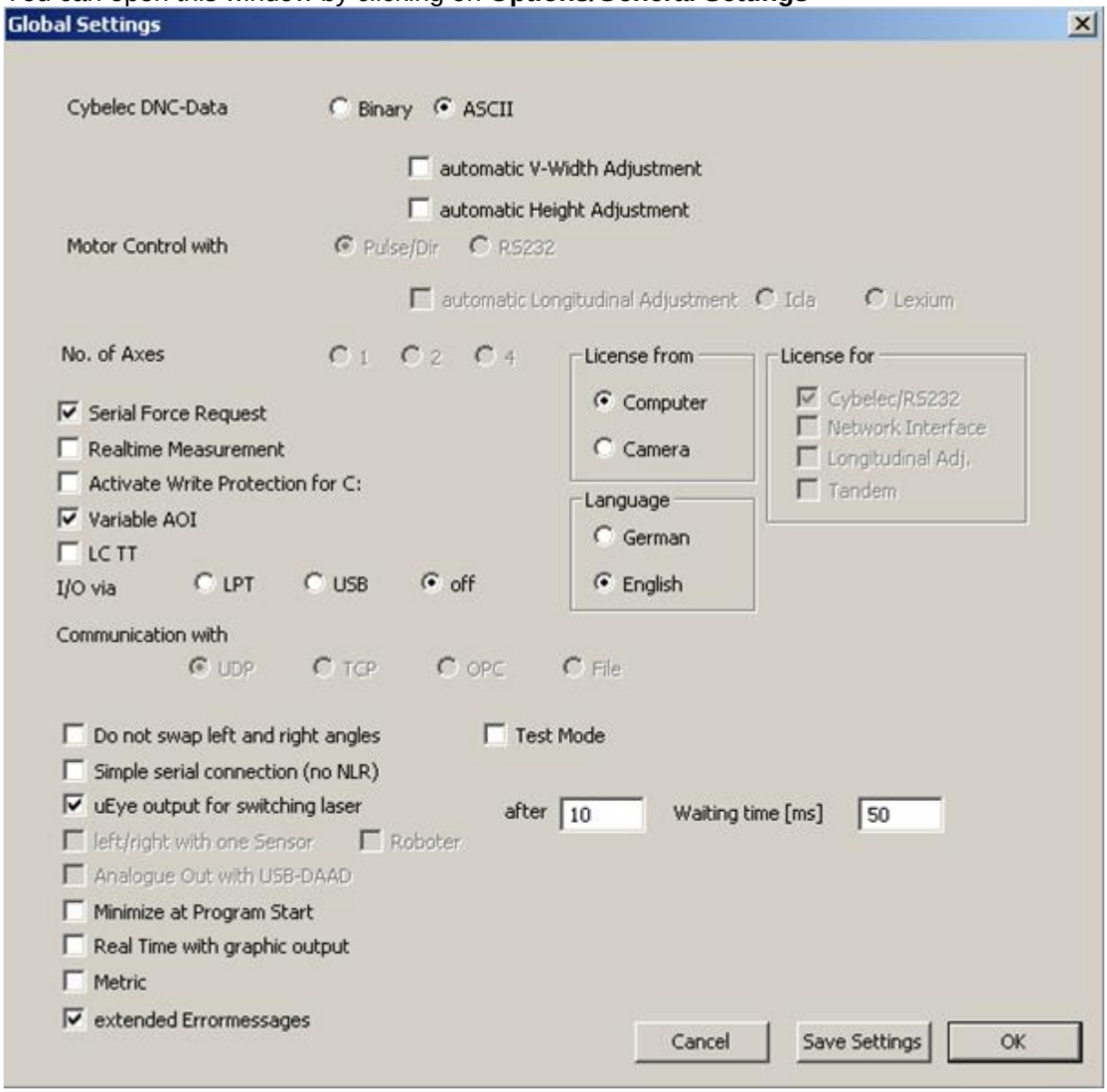
1. An individual sensor can be activated or deactivated in the LaserCheck *dialogue* **Options/Angle measurement**. **In order to be active** (**in ON state**)**, a sensor must be activated in the LaserCheck program!**
2. In addition to the interactive control of the sensors, all attached sensors are looked up and tested automatically when the program starts. If an attached sensor does not function correctly, it is deactivated automatically (OFF state) and its respective window is not opened.
3. **If you are calibrating a sensor with the data M calibrator or if the system is operating with the press brake control, the live mode of each sensor should be deactivated!**
4. If you are calibrating a sensor with the data M calibration unit, it must be in the ON state, otherwise a calibration is not possible.

The file **LaserCheck.par** contains all adjustable parameters of the LaserCheck program. Each modification in the input dialogs of the program must be stored in the *menu* **Program/Settings/Save**. Otherwise the new adjustment will not be available after the next program start.

Warning: Do not edit the file *LaserCheck.par* **manually.**

2.4. General Settings

You can open this window by clicking on **Options/General Settings**



Binary/ASCII is the type of encryption the LaserCheck computer uses for the communication with the Cybelec control. This option is only available if you use a Cybelec-control

Automatic V-Width Adjustment must be selected, if you use an automatic V-Width adjustment. If you want to use this also see 7.1 Automatic V-Width Adjustment on page 81.

Automatic Height Adjustment must be selected, if you use an automatic height adjustment. If you want to use this also see 7.2 Automatic V-Height Adjustment on page 82.

If you either use an automatic height or V-Width adjustment, the buttons **Motor Control with** will become available. You can choose between two methods of communication: **Pulse/Dir** and **RS232**.

If you have the appropriate license the option **Automatic Longitudinal Adjustment** becomes available. You can choose the type of motor you want to use, **Icla** or **Lexium.**

The **No. of Axes** is equivalent to the number of motors. It is used for the longitudinal adjustment. You can move two sensors with **1** motor, two sensors with one motor each, four sensors with **2 motors each** or four sensors with **4** motors each.

The box **Serial Force Request** must be activated if you connect the force amplifier to a control that uses serial communication, e.g. Delem.

If **Realtime Measurement** is active, a measurement is done whenever the camera takes a picture. Otherwise a measurement is only done when the control requests it.

If you **Activate Writing Protection for C:** the writing protection of the LaserCheck computers drive C: is active. Also see 9. Automatic Write Protection (EWF) on page 95.
Variable AOI must be activated if you use a LaserCheck-system with variable AOI, meaning LaserCheck 8, 9, 10, 11. Also see 5. Variable AOI (area of interest) on page 75.
LC TT must be activated if you use LaserCheck TT.
With **I/O via LPT/USB/off** you must set, how the LaserCheck-sensor is controlled. You can choose **LPT or the parallel port** for LaserCheck 6 and 7, **USB** for LaserCheck 8 and 10 or **off**, if you use a network connection (LaserCheck 9 and 11)
Communication via UDP/TCP/OPC/File determines the way the controls with serial communication interact with the LaserCheck-computer. **UDP** is used for Delem, **TCP** for ESA and Bystronic, **OPC** for Siemens Simotion and **File** for other controls.
If for some reason a sensor does not work, LaserCheck will assume that both sensors measured the same angle. If you do not want this, activate **Do not swap left and right angles**
Simple serial connection (no NLR) must be activated if you want to use a serial communication system other than Cybelec.
uEye output for switching laser shuts the laser down have been inactive for a time period exceeding the one set in this window. There is also a **Waiting time** after the laser has been started again, because it first of all has to adjust its brightness.
The Option **left/right with one Sensor** is used for the longitudinal adjustment. It means that the sensor will move to the left side, take a measurement, then move to the right side and take another measurement there. You can also use the option **Roboter** if you want to use one. In this case the sensor will move to a parking position after measuring.
The option **Analogue Out with USB-DAAD** is used for the Tandem-mode. Also see 1.7 Tandem Option for Cybelec on page 55.
If you want to **Minimize at Program Start** use this option.
Real Time with graphic output also displays the sensor picture whilst being in real time mode.
If **Metric** is active, you can enter numbers with one decimal place. If this option is inactive you can enter numbers with three decimal places.
If **Extended Errormessages** is active, it will also display all error messages from the uEye-driver, which is used to control the cameras.
License from Camera/Computer determines on which device the license is saved. If you choose **Computer** you can connect any sensor to this computer. If you choose **Camera**, you can use the camera with any computer.

3. Image Processing and Angle Measurement

Once you have established the connection between the LaserCheck device and the Delem network card, the system can start measuring the bending angle. If you want to change the measuring parameters you can open the dialog box Angle Measuring Parameter in the *menu* **Options / Angle measurement** (F2). The input is divided into 3 parameter groups:

1. Image processing
2. Plausibility of the measured angle
3. Mounting position of the sensors

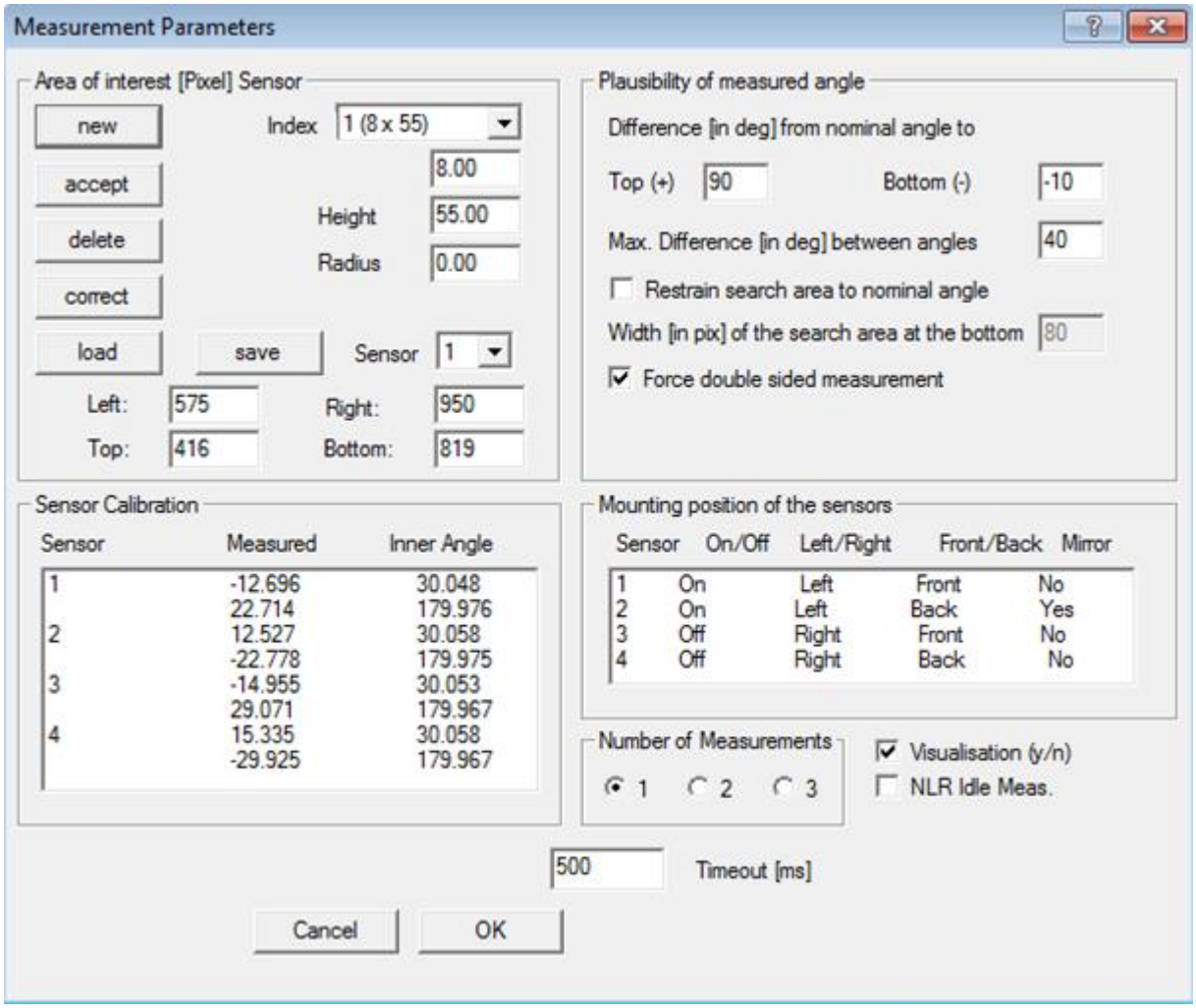


Figure 57: Angle measurement parameters

The following parameters can be set:

Area of interest: Search area of the laser line in pixels for each sensor. The values define a rectangle, inside which the LaserCheck program searches for the laser beam.

For Variable AOI see 5. Variable AOI (area of interest) on page 75.

Plausibility of measured angle: For checking the plausibility, a nominal angle is transmitted from the Delem control. The difference between these angles must not exceed the difference between **Top** and the **Bottom** value. Additionally the maximum acceptable asymmetry of the front and back angle can be limited (**Max Difference between angles**). In the case that the plausibility check fails, an error angle of 180° is sent.

The enabled switch **Force double sided measurement** only prevents single sided measurements. Even if an angle is fine, an error is generated. Normally the flange angles are non-symmetrical, therefore a single side measurement is not precise and distorts the bending solution significantly. This option can also be activated via parameter 59 in the parameter file.

The search area of the laser beam can be limited by a V-shaped area around the nominal angle by activating the option **Restrain search area to nominal angle**. The area is defined by the upper and lower limits of the deviation from the nominal angle, and by the value **Width of the search area at the bottom** which is located around the horizontal centre of the area of interest.

The parameter **Number of measurements per sensor** indicates, how many measurements are executed, before their average value is transmitted to the control.

The check box **Visualisation** enables/disables the output of the results in every sensor window; disabling increases the measuring speed.

Real Time Measurement allows an angle measurement triggered by the cameras.
The **Timeout** limits the process time needed for detecting an angle.

Sensor Positions

The definition of the **mounting position of the sensors** must be set individually for each sensor. By **double clicking** on the corresponding sensor entry…

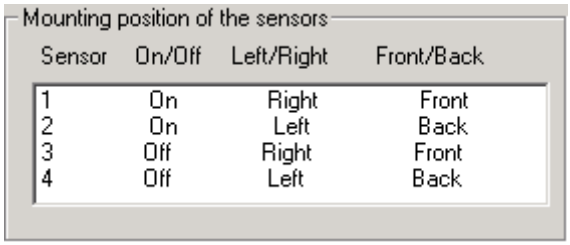

Mounting position of the sensors
Sensor On/Off Left/Right Front/Back
1 On Right Front
2 On Left Back
3 Off Right Front
4 Off Left Back

Figure 58: Sensor position

…the following dialog opens:

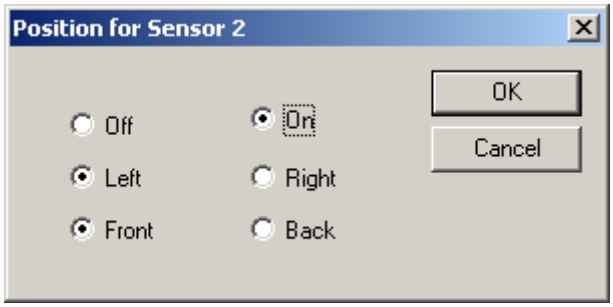


Figure 59: Definition of sensor position

The individual radio buttons define the mounting position of the selected sensor. If you only use **2 sensors**, **both must be on the Left**, one in the back and one in the front.

If you have double definitions you will obtain the following type of error messages

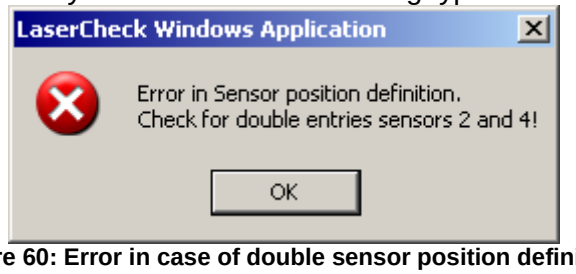


Figure 60: Error in case of double sensor position definition

Important Notes:

If you want to reuse all of the above mentioned parameters in future sessions, you need to save them onto the hard disk using the menu Program/Save!

4. Laser Line Detection Parameters

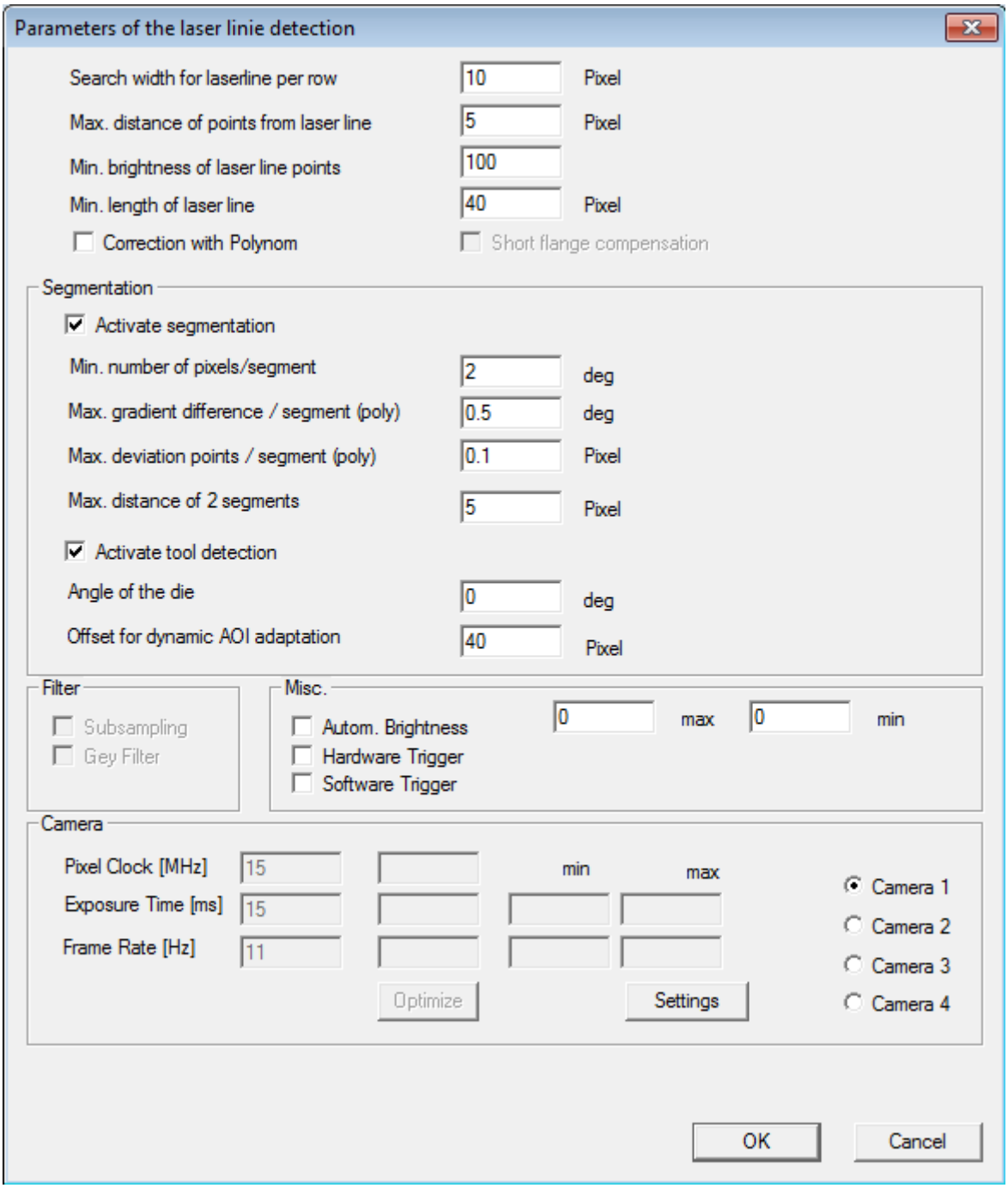


Figure 61: Laser line detection

The laser line is not always perfect due to environmental influences or different degrees of reflection off the surface of the sheet metal. Sometimes it is not even possible to measure the laser line. This can be due to too short flanges or existing flanges hiding the camera. Therefore you can adjust the laser line detection parameters. Open this window with **Options/Image processing** or by pressing **F3**.

4.1. Plausibility

The following parameters test the plausibility of the obtained result:

- **Search width for Laserline per row** indicates the maximum range of values ± n pixel around the brightest point of a line. If several "brightest points" are found in a line, then the left most point is stored. The tolerance indicates how many pixels a brightest point can be away from the laser line without being rejected.
- **Max distance of points from laser line:** With the help of linear regressions, we calculate the average laser line, only taking points into account which are separated by fewer pixels than the indicated value.
- **Min brightness of laser line points:** In each line we search for the brightest point – having at least the minimum brightness. The value varies from 0 for a black point to 255 for white one.
- **Min length of laser line:** If the detected line is shorter than this value, it will be rejected.
- **Correction with polynom** or polygon
- **Short flange compensation** is automatically active for sensors with AOI. It is used to measure short flanges with a minimum error.

4.2. Segmentation

First we try to detect anything that looks like a laser line. The result is a list of non-continuous line segments. The number of segments is controlled by:

- ***Minimum number of pixels per line segment***
- Segments can be connected if their intersection angle is lower than ***Max. gradient difference / segment***.
- New line segments are created when the distance of a point exceeds ***Max. deviation points / segment***

  Max distance of 2 segments is the highest possible distance from the end point of the last segment to the sum of all segments already connected.

Now we have one long connected line potentially representing the true laser line reflection on the sheet flange. Then we take all the points from the beginning to the end of the segment and make a linear regression. If tool detection is active and we obtain an angle smaller than the ***angle of the die***, we can be sure that we have detected the reflection of the lower die.

If we have detected the die at the bottom of the image we take the end of the detected line, add the value of the ***Offset for the dynamic AOI adaptation*** (Parameter 30) pixels and restart the line detection process.

4.3. Additional Camera Settings

The parameters Pixel Clock, Exposure Time and Frame Rate change basic settings of the camera. The maximum possible value for the pixel clock is limited by the transfer rate of the USB bus. This can be tested with the program uEye Cockpit, installed on the LaserCheck computer. The exposure time controls the image brightness. The frame rate determines the number of images transferred per second. All values are dependent on each other:

- The ***pixel clock*** divided by the image size is the maximum ***frame rate***.
- The exposure time must be smaller than 1/frame rate * 1000.

4.4. Detection Results

The image below shows some characteristic items which the user of the angle measurement system should observe while bending:

1. The green marker must be visible (only when the segmentation option is activated) in the sensor image. If this is not the case, the measurement is not taken, due to the following reasons:
    a. Line is too short
    b. Line angle is outside the limits
    c. Laser line is too dark, all points are below minimum brightness for line points
2. The blue lines show a V shaped region defined by the set angle given by the Delem control and by the upper and lower limits of the deviation from the set angle. Parts of the laser line must be inside this region, the rest of the line points are rejected.

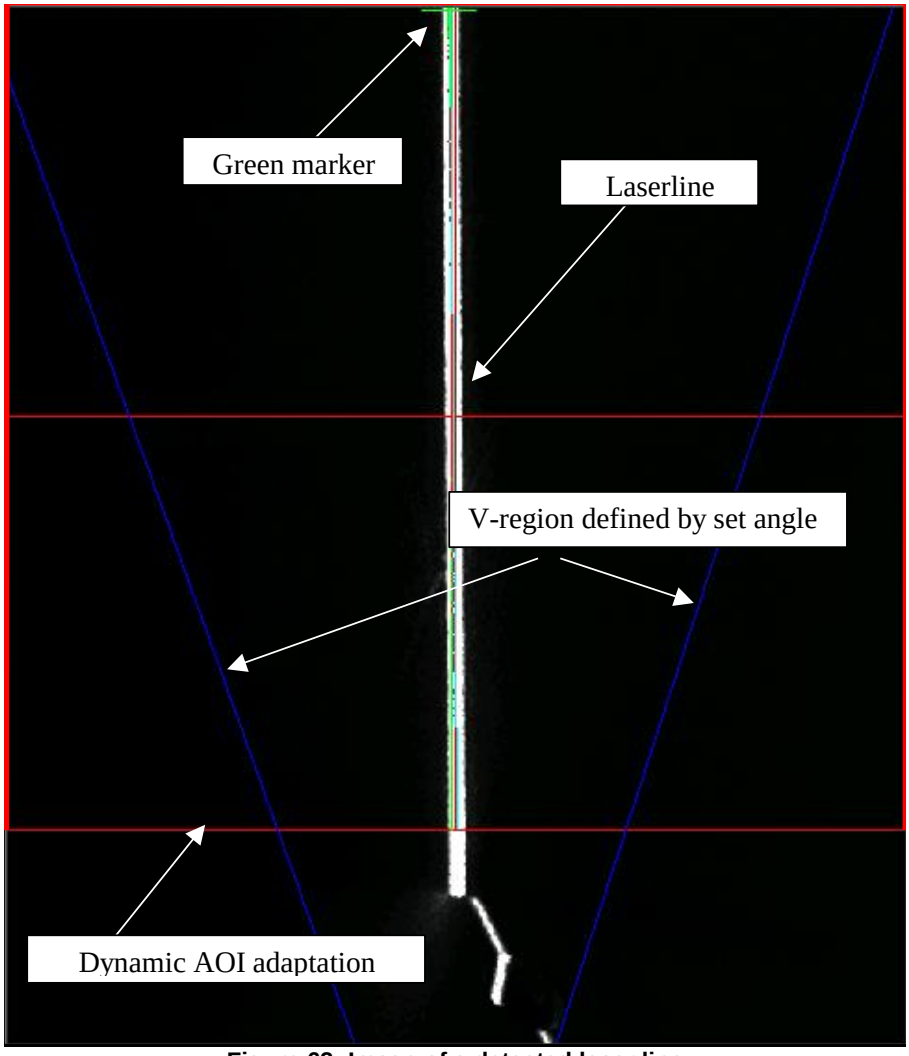


Figure 62: Image of a detected laser line

3. In this example the image shows some perturbations at the bottom. The AOI is automatically adapted to the top. In this area 2 potential laser line segments are visible but they are rejected as either their angle is below the die limit angle or their length is too short.

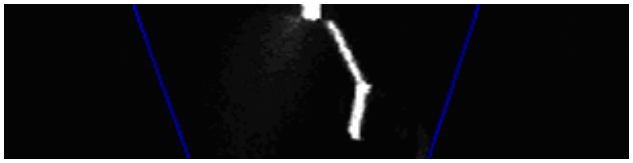


Figure 63: Zoom of a perturbation area

4. The next example shows 2 overlapping sheets. On the left, the segmentation option is activated. The green marker in the centre of the image marks the end of the good part of the laser line. The rest of the laser line is discarded. On the right, the image segmentation is not activated. The real angle is erroneous because the laser line angle is determined as the average of both lines.

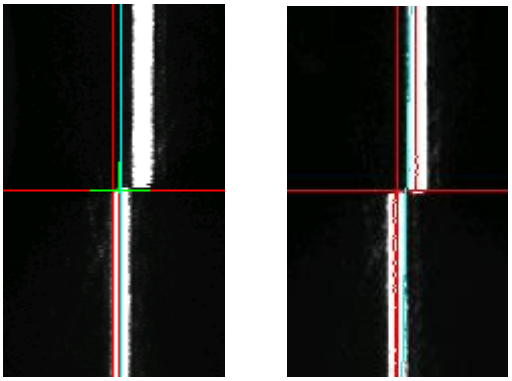


Figure 64: Zoom of 2 overlapping sheets:
Left with segmentation option, right without

4.5. Short flange compensation

If the option variable AOI is activated, short flange compensation is automatically activated, too. In order for this function to work properly, the laser line must be completely confined by the AOI for every angle. The program can then artificially elongate the laser line, in order to improve the measurement result. If the variable AOI is deactivated, this option is automatically deactivated, too.

5. Variable AOI (area of interest)

If you want to use LaserCheck 8, 9, 10 or 11, you need a variable AOI. These sensor types are not adjustable in the V-width and therefore the working distance constantly changes during a tool exchange. You need the variable AOI in order to find the correct position of the sheet metal and to select the correct calibration data. **All dies needed must be defined and calibrated individually.**
The option Var. AOI must be selected in the General Settings Dialog Box.

5.1. Die Definition

We need the data of every tool that is going to be used in production later on, as all of these tools must be calibrated. Important is only the tool's V-Width and height, and also its radius if there is one. Select **Options/Measurement** or press **F2** to open the Measurement Parameters dialog box:

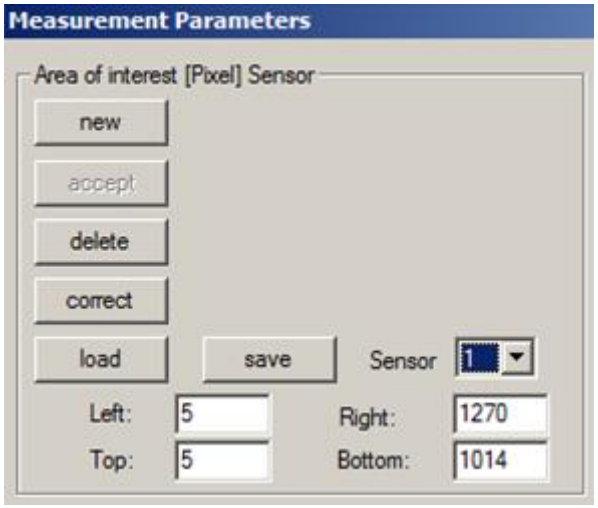


Figure 65: Measurement Parameters Dialog Box

Select **new**. A New Die dialog box opens.

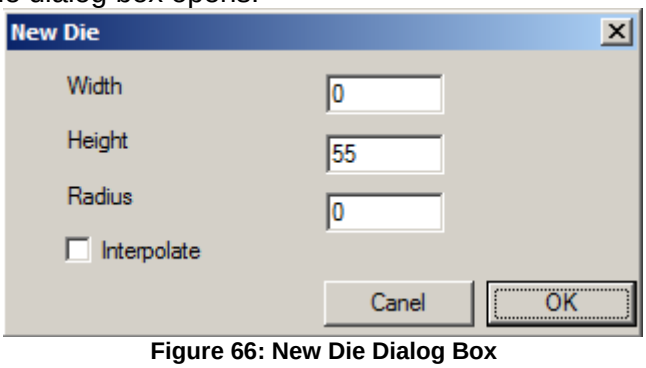


Figure 66: New Die Dialog Box

Input width, height and shoulder radius.
In order to save this tool, you have to click on **accept.** Enter all tools, following these steps. Take care not to list any tool more than once.

5.2. Switching the AOI

Just like with LaserCheck 6 and 7, the AOI has to be adjusted according to the laser line. As soon as a die is chosen by the control or the LCAdjust program, this die is shown in the headline of the LaserCheck-program.

Figure 67: Sensor headline

5.3. Additions for LaserCheck 10 and 11

When using LaserCheck 10 or 11 there are no left or right sensors, as they all have the same hardware. Thus sensor 2 and 4(back) must be **mirrored.**

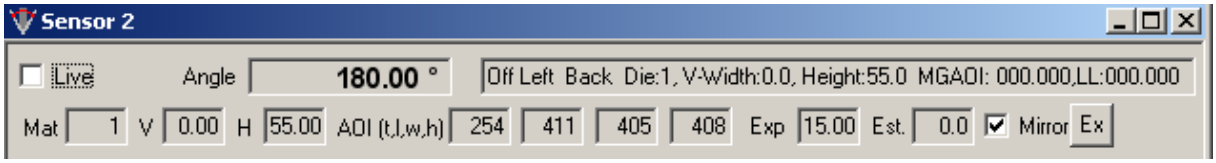

Sensor 2
Live
Angle
180.00 °
Off Left Back Die:1, V-Width:0.0, Height:55.0 MGAOI: 000.000,LL:000.000
Mat 1 V 0.00 H 55.00 AOI (t,l,w,h) 254 411 405 408 Exp 15.00 Est. 0.0 Mirror Ex

Figure 68: Sensor headline with activated mirror-option

If you want to change the AOI, you have to deactivate the mirror-option first!

5.4. Correcting the Calibration

After calibrating a tool, you can click on **correct** in the Measurement Parameters window and the **Angle Correction** dialog opens:

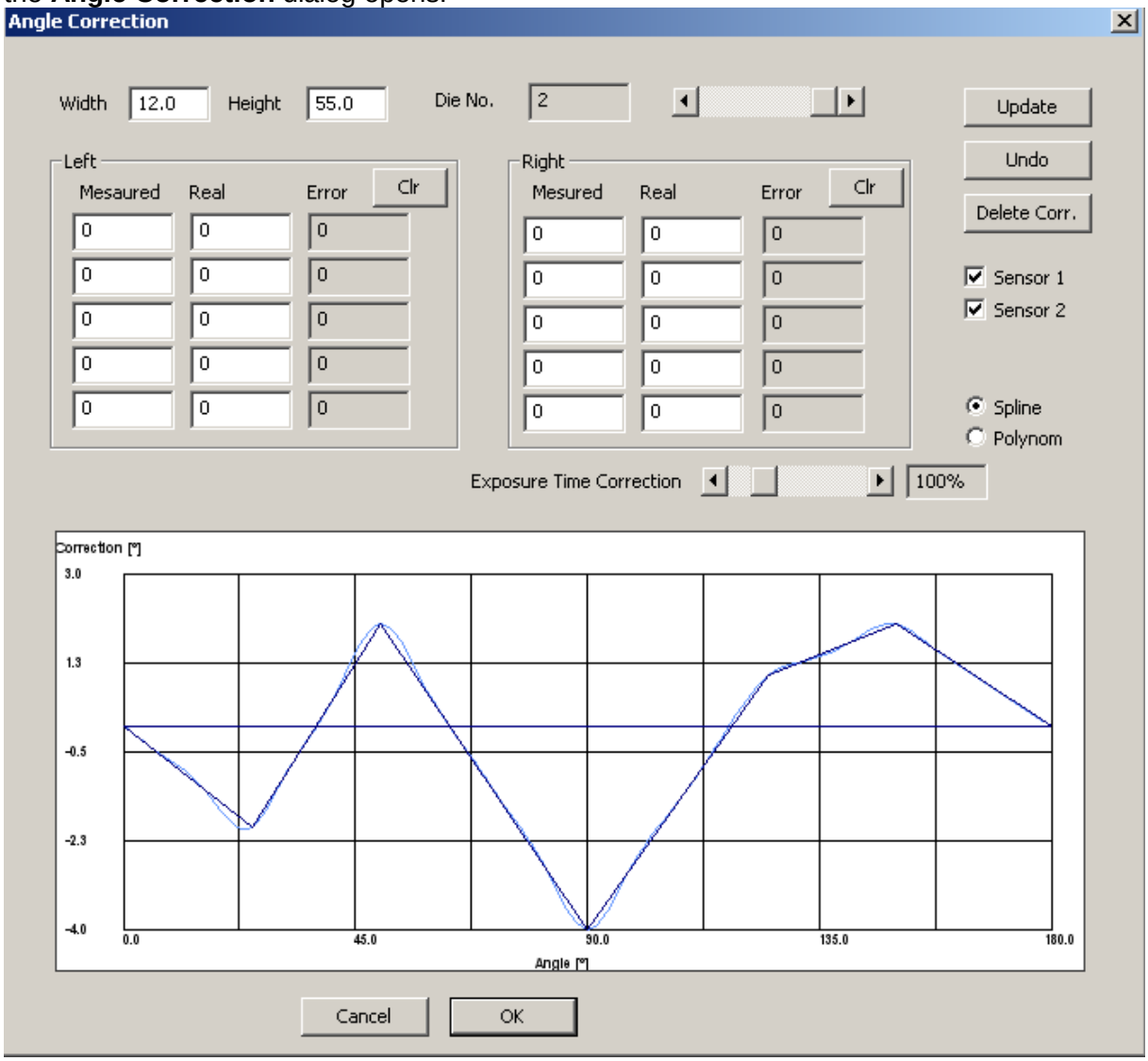
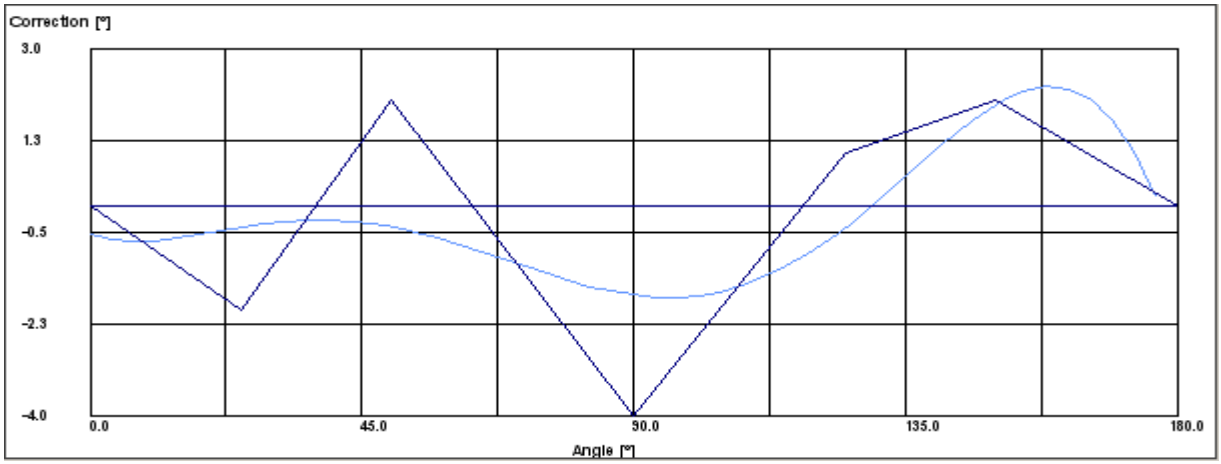


Figure 69: Angle Correction dialog

You can choose the die you want to correct by using the upper scrollbar. Then you can enter the measured angle and the real angle for each sensor as corrections into the tables. These values are shown by the black line after you click on **Update**. Also values for all other angles are interpolated from this line. The way this is done can be chosen: **Spline** or **Polynom**. By choosing spline a linear correction is calculated, as shown above. If you choose polynom the program will calculate a function from those points and you will see a curve like the one in the picture below:



Also you can change the **Exposure Time** for every die individually by a certain percentage if you adjust the lower scrollbar. The adjusted percentage only applies to the die that is currently chosen. We recommend adjusting the exposure time under Options/Correction Material for a die with a medium distance and then using this option to adjust the exposure time for all other dies, if necessary.

6. Real Time Measurement for Delem and Cybelec (Option 66)

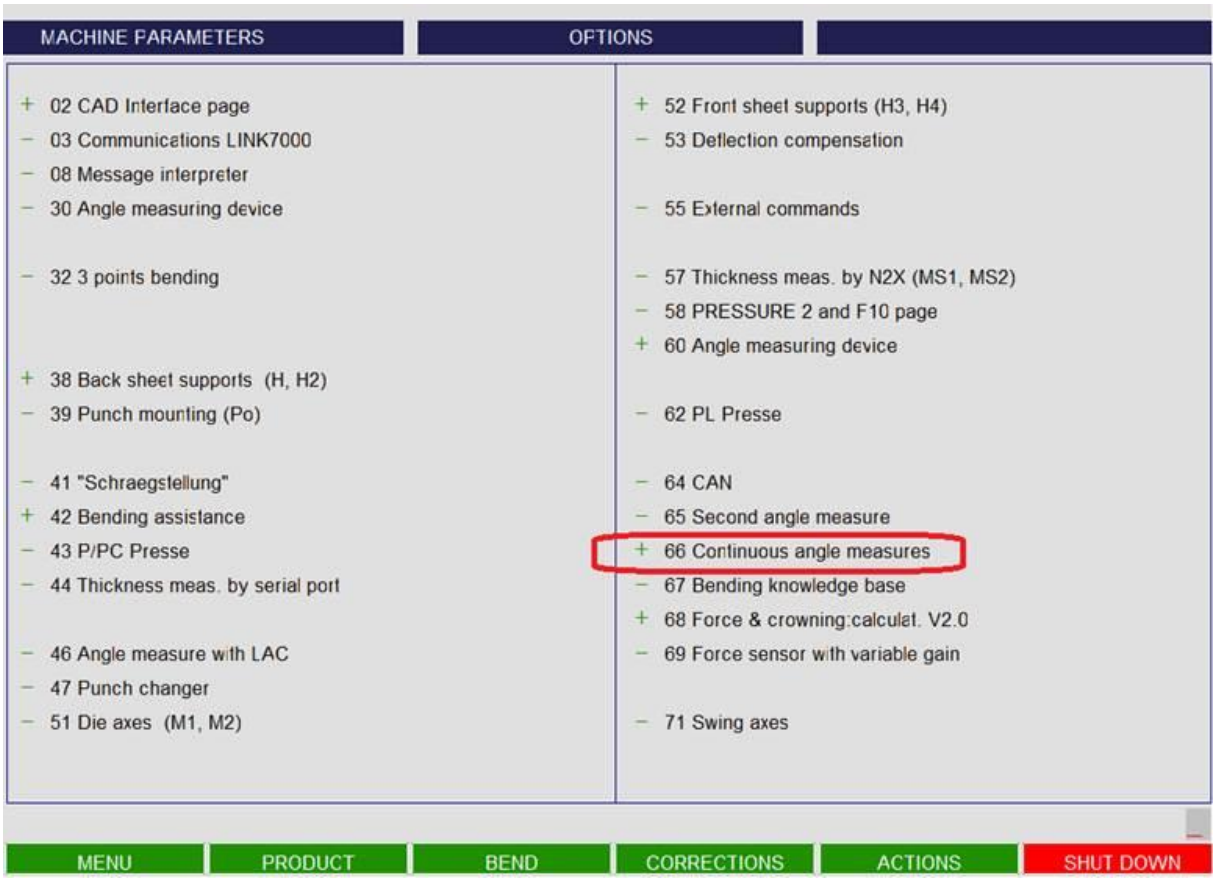
6.1. General

The Real Time-option can be activated in the window **Options/General Settings** and by clicking on **Real Time Support for Cyb. Opt. 66 and DM101RS.** Also the options **Real Time with graphic output** and **Real Time with Force Measurement** are available.
Real Time measurement means that the LaserCheck-sensors constantly take pictures (not only when triggered), which are processed and sent to the control. This type of measuring has the advantage that the bending process does not need to be stopped at any point. The difference between Delem and Cybelec is that Cybelec requests an angle and thereupon receives the newest one. Delem on the contrary has an open input to which angles are sent to continuously.

6.2. Cybelec

6.2.1. Option 66

Activate option 66 on the **Machine Parameters**-page by replacing the "—" with a "+".


MACHINE PARAMETERS
OPTIONS
+ 02 CAD Interface page
− 03 Communications LINK7000
− 08 Message interpreter
− 30 Angle measuring device
− 32 3 points bending
+ 38 Back sheet supports (H, H2)
− 39 Punch mounting (Po)
− 41 "Schraegstellung"
+ 42 Bending assistance
− 43 P/PC Presse
− 44 Thickness meas. by serial port
− 46 Angle measure with LAC
− 47 Punch changer
− 51 Die axes (M1, M2)
+ 52 Front sheet supports (H3, H4)
− 53 Deflection compensation
− 55 External commands
− 57 Thickness meas. by N2X (MS1, MS2)
− 58 PRESSURE 2 and F10 page
+ 60 Angle measuring device
− 62 PL Presse
− 64 CAN
− 65 Second angle measure
+ 66 Continuous angle measures
− 67 Bending knowledge base
+ 68 Force & crowning:calculat. V2.0
− 69 Force sensor with variable gain
− 71 Swing axes
MENU
PRODUCT
BEND
CORRECTIONS
ACTIONS
SHUT DOWN

If LaserCheck is continuously taking measurements, the beam is lowered at a constant speed without any stops. Starting from the distance which is set in **parameter 206** (final approach) the machine moves slower. The speed is lowered even further when the machine approaches the BDC (adjustable in **parameter 214** advanced stop). When the machine reaches the BDC, the spring back measurement is done. The machine is released with the speed set in **parameter 220**, until the angle change in °/s is lower than **parameter 213**. Then the spring back is measured, we overbend and the piece is finished.

6.2.2. Parameters for continuous measurement

206: Final approach
The default value of this field is **1.5mm**. (Transformed into degrees as a function of nominal tools, thickness and target angle.) This value will be used instead of the normal one (parameter 03, on BEAM page) when using an AMD under CONTINUOUS MEASURES. It is wise to use a relatively wide final step, which is performed at a lower speed, thus reducing the danger of overshooting. If the final step is too wide, it will slow down the bending process considerably.

210 Closed loop cycle
The default value of this field is **10**. When the upper tool, whilst being measured continuously, is just in front of the lower dead centre (see parameter 214), the NLR gives the instruction to correct the beam's downward position in steps of 1 Y-encoder unit, until the target BDC angle is reached. These orders overlap and interfere with the usual bending process, hence they cannot be given too frequently. However, if they are given too scarcely, it will take too long to reach the target angle. For technical reasons (precision), the time between orders is given in "internal NLR cycle counts", not in seconds. One cycle roughly lasts for about 10 ms. With insufficient values, the sheet metal will oscillate when approaching BDC. With excessive values, it will take too long to reach the BDC. Hence, first try lower values and increase them until you have found a configuration which is stable for most bends.

211: Spring back measurement cycle
The default value of this field is 0.3s, but we recommend **0.1s**.The NLR-card continuously compares the current angle with an older one in order to determine when the angle ceases varying. This parameter determines the time period between these angles. Parameter 211 must be short for the lifting speed to be high; it must be longer for lower speeds. If the given time period is too big, the risk of releasing the sheet will be higher. If it is too short, there is an increased risk that the software will be too late at detecting the slower change of the angle and hence it will stop too early. Moreover, the process can be influenced by random, non-repeatable incidents such a sensor noise or slip stick effects.

213 Spring back measurement tolerance
The default value of this field is **4**. For technical reasons (precision), this parameter is given in digital angle values, not in degrees. Under continuous measures, the NLR steadily compares the current angle value with an earlier, older one, to detect when the angle ceases varying. This parameter determines by how much the angles must differ. Common values are between 2 and 4 which typically corresponds to about 0.1°. Too large values might cause the lifting to be terminated when the elastic spring back has not yet sufficiently expressed itself. The resulting spring back angle would be underestimated. Values which are too small can be unreliable, due to the presence of noise (not only at the sensors, but also due to slip-stick effect), which might occasionally cause the procedure to stop in a random, unrepeatable fashion. Moreover, the risk of releasing the sheet is higher.

214 Advanced stop
The default value of this field is **0.1mm**. Transformed into degrees as a function of nominal tools, thickness and target angle. The speed below this distance is set to the regulation speed (the slowest possible speed), whilst being measured continuously. Corrective displacements of plus or minus 1 Y-encoder unit are possible.

220 Speed spring back measurement
This speed will be converted into mm/sec as a function of BDC angle, thickness and tools. The beam will rise with this speed during the spring back measurement cycle, thus adapting to the bending conditions, especially to the die opening. This speed is limited to the maximum upward bending speed (parameter 13 on BEAM page).

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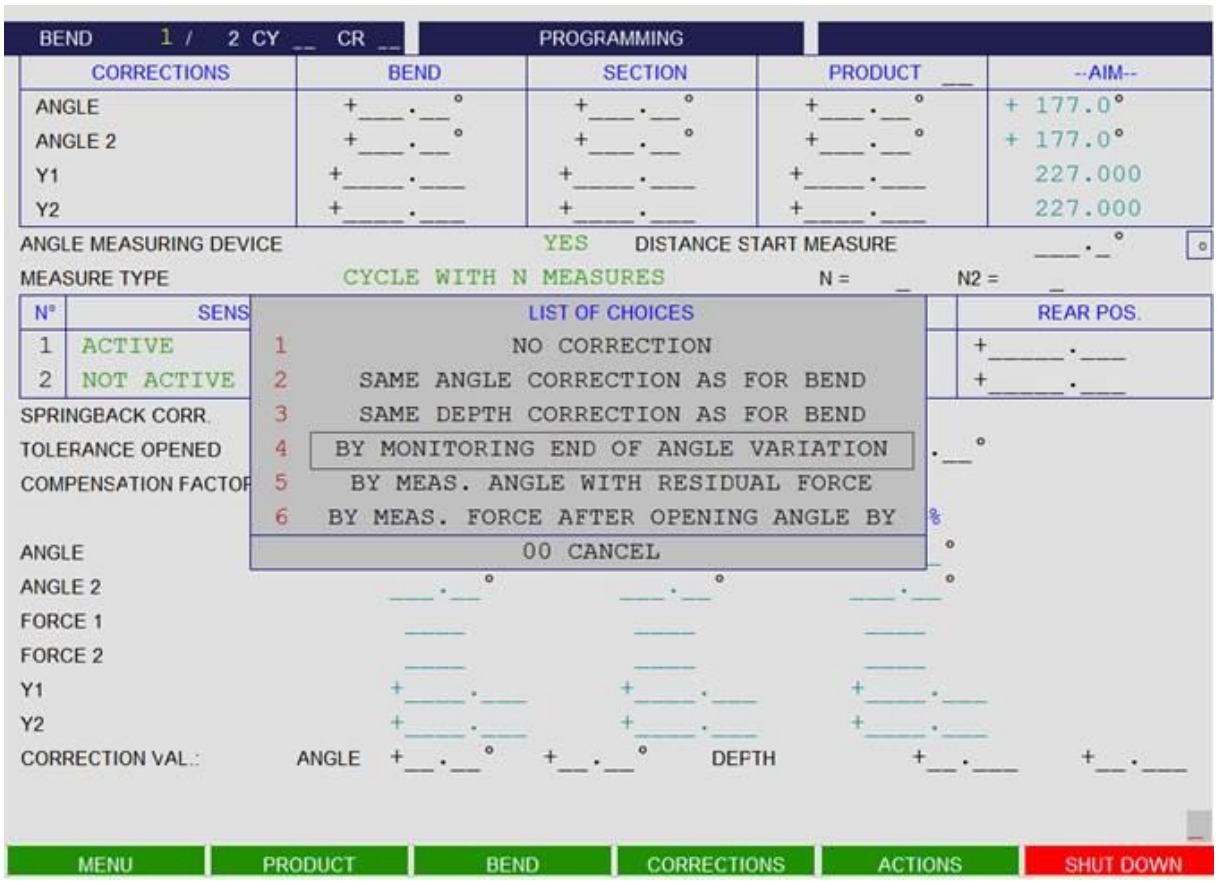
If you want to bend using continuous measurements, you have to choose the spring back method **by monitoring end of angle variation.** Also see 1.6.11 Bends with Spring Back Measuring Variants on page 51.



7. Sensor V-Adaption Control

The sensor adaption control moves the sensors according to the width and height of the current die. The necessary information is sent from the control to the LaserCheck system before each bend. For adjusting the sensors both, the height and the width adjustment axes must be in their reference position.

7.1. Automatic V-Width Adjustment

The sensors are calibrated for a constant distance to the sheet flange. Changing the die (different V width) results in a modified position of the sheet flange with respect to the center plane of the machine. In order to compensate for this variation the sensors are equipped with stepping motors. These are connected to the parallel port of the LaserCheck computer via a special cable and controlled by the LaserCheck program. During motor operation, all user inputs to the computer are blocked.
The press brake control sends the programmed V-width information directly to the LaserCheck computer. This information will be updated before each new bending step.
The following parameters in the parameter file control the distance:

67 : 1 0 // System with (1) without (0) motorized V-width control, motorized V-height control
115 : 60 // max. Range V-Width in mm

Parameter 67:

In order to activate the program option automatic distance control, parameter 67 must be 1.

Parameter 106:

Max. course of the sensors in horizontal direction

Also **automatic V-width adjustment** must be activated in **Options/General Settings.**
For the adjustment of the distance control you can use the following dialog:

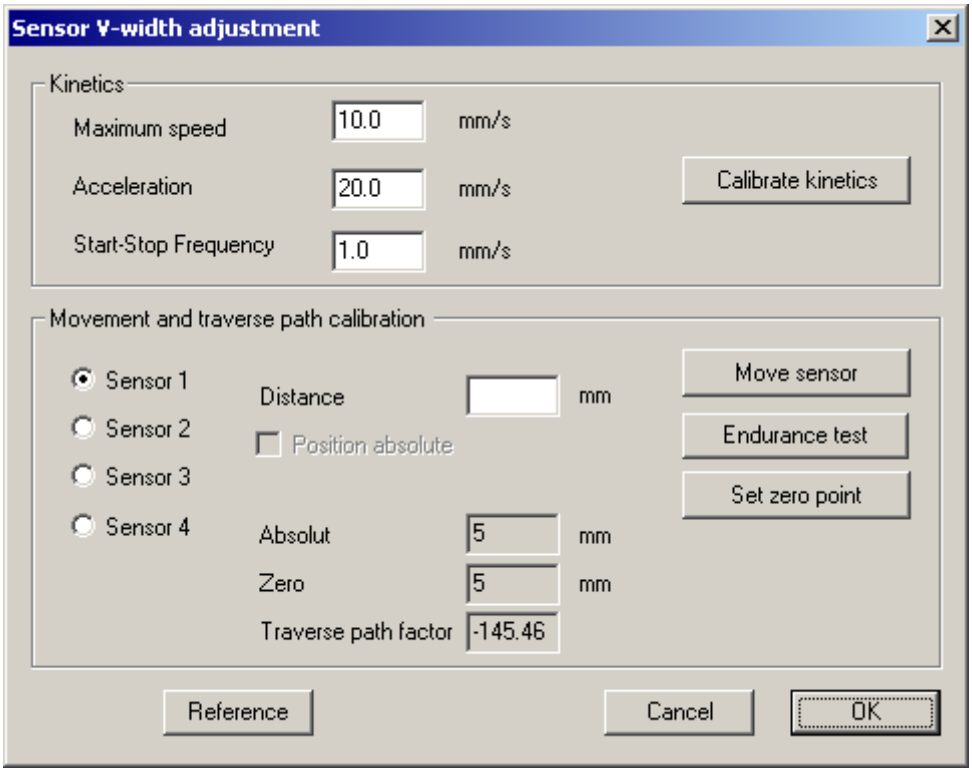


Figure 70: Dialog to adjust the sensor distance control units

In this dialog you can adjust the kinetics of the sensor movement: **maximum speed**, **acceleration**, **start-stop frequency**. If you install the software on the computer for the first time you must also calibrate the computer by pressing the **Calibrate kinetics** button.
You can move each sensor individually by first selecting the desired sensor, then entering a value into the **Distance** field. This is a relative distance. A negative value moves the sensor to the machine center, a positive value moves it in the opposite direction. In order to start the movement, press the **Move sensor** button.
When you adjust the sensors, move the sensors to a position about 1 mm from their back stop. Adjust the laser and the camera in such a way, that the laser beam is centered. Then save the zero point by pushing the **Set zero point** button. From then on this point can be reached immediately by pressing CTRL+S.
The **zero position** can be tested by pressing CTRL+R. The sensors will move synchronously inwards to their mechanical back stop position. They will move for the duration corresponding to the distance of their maximum course (Parameter 106).

Remark:

If the sensors are not referenced correctly, the angle measurement result will be erroneous as the sensor position with respect to the sheet will be wrong.

7.2. Automatic V-Height Adjustment

The press brake control sends the programmed die number directly to the LaserCheck computer. Before each new bending step this information will be updated. The die height corresponding to the Delem die number must be programmed in the LaserCheck program. If the number is not available a relative height of 0 is used.

The following parameters in the parameter file are used for the height control:
67 : 1 1 // System with (1) without (0) motorized V-width control, motorized V-height control
115 : 100 // max. Range V-Height in mm
118 : 80 // Relative Height Position after Reference in mm

Parameter 67:

In order to activate the option Automatic height control, both parameters 67 must be 1.

Parameter 115:

Max. course of the sensors in vertical direction

Parameter 118:

Die height that is corresponding to the reference position. The reference height is adjusted with the calibration unit. The height of the shaft is the die height in reference position.

Furthermore **automatic V-height adjustment** and **automatic V-width adjustment** must be activated in **Options/General Settings.**
For the adjustment of the height control you can use the following dialog:

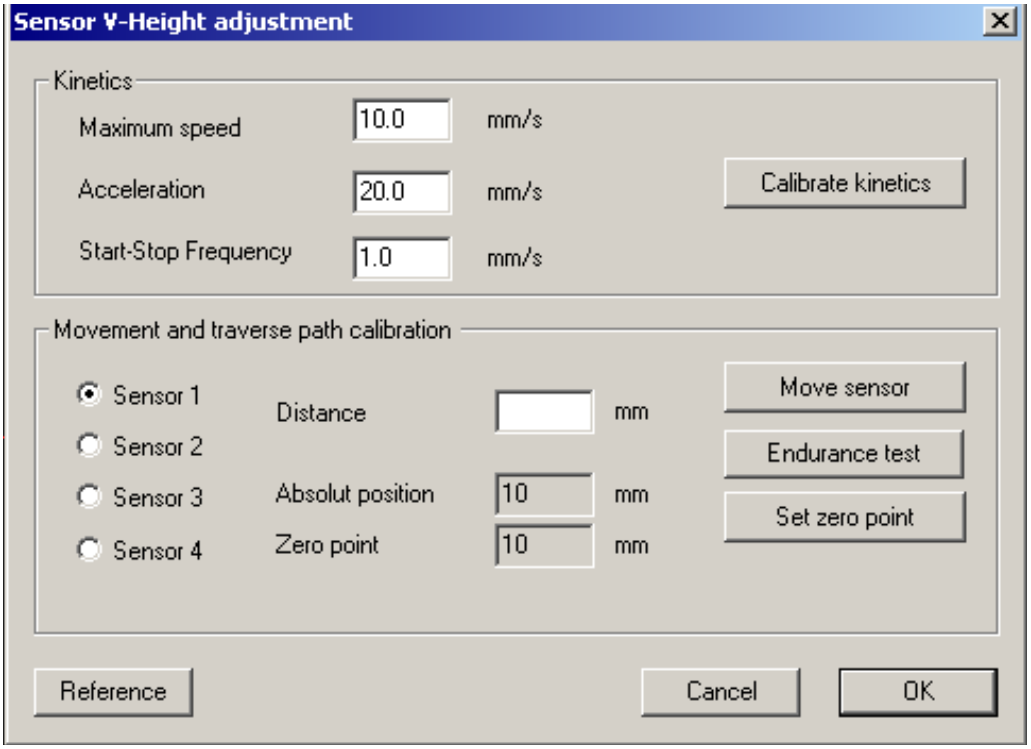


Figure 71: Dialog to adjust the sensor height control units

In this dialog you can adjust the kinetics of the sensor movement: **maximum speed**, **acceleration**, **start-stop frequency**. If you install the software on the computer for the first time you must also calibrate the computer by pressing the **Calibrate kinetics** button.
You can move each sensor individually by first selecting the desired sensor, then entering a value into the **Distance** field. This is a relative distance. A negative value moves the sensor downwards, a positive value moves it upwards. In order to start the movement, press the **Move sensor** button.
When you adjust the sensors, move the sensors to a position to their lower back stop. Adjust the laser and the camera in such a way, that the laser beam is centered. Then save the zero point by pushing the **Set zero point** button. From then on this point can be reached immediately by pressing CTRL+S.
The **zero position** can be tested by pressing CTRL+R. The sensors will move synchronously inwards to their mechanical back stop position. They will move for the duration corresponding to the distance of their maximum course (Parameter 106).

Remark:

If the sensors are not referenced correctly, the angle measurement result will be erroneous as their position with respect to the flange will be wrong.

Figure 72: LaserCheck with height adjustment

7.3. V-Adjustment for bending

The press brake control sends the programmed V geometry information directly to the LaserCheck computer.
Before each new bending step this information is updated. You can check the current V-parameters in the following dialog.

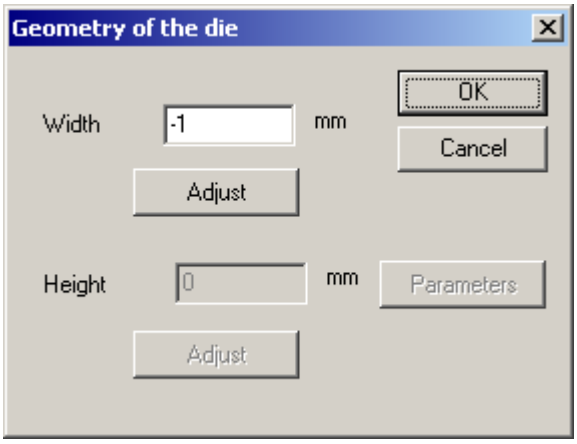


Figure 73: Dialog to adjust the sensors according to the current die geometry

Additional parameters for the height adjustment can be set by pressing the **Parameters** button. The following dialog will be opened:

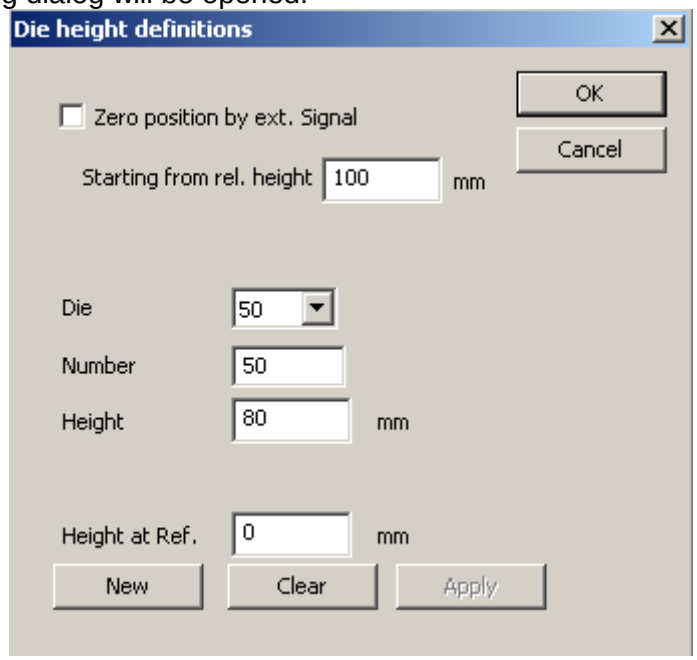


Figure 74: Dialog to define new die heights.

For adding a new die, push the **New** button and enter the corresponding die number (1-99) and the corresponding die height. Pushing the **Clear** button will delete the current die settings from the list. Once you have changed the parameters you must push the **Apply** button. Setting the checkbox **Zero position by ext. Signal** moves the sensor down to its zero position, if the current height is bigger than the limit indicated in the **Starting from rel. height** field.

The value **Height at Ref** is the corresponding die height at the reference position. You can use your calibrated height as the reference height. Input the height of the shaft. Measure this height in the same way you measured the height of the tool.

Don´t forget to save the parameters!

7.4. Automatic Longitudinal Adjustment

Options for longitudinal adjustments are:

1. One motor driving two sensors. Front and back sensor are moved by one motor
2. Two motors are driving two sensors. Front and back sensors are moved separately.
3. Two motors are driving four sensors. Front and back sensors are coupled with one motor.
4. Four motors are driving four sensors. Each motor is moved separately.

General Remarks:

Longitudinal adjustment is designed to move the sensors on robotized press brakes out of the collision area of the robot. It can also be used to take measurements on the left and the right using a pair of sensors, in order to get 2 angle values for a bend. There are 2 types of motors available:

- The intelligent stepper motor Schneider Lexium ILS1 with a CANOpen interface.
- The servo motors Schneider BSH, BDH with a servo controller Lexium32

Both types of motors are controlled by LaserCheck via a CAN-Interface type PEAKCAN USB or PEAK PCI. In order for the CANOpen interface to function, the CANOpenStack.dll, Hardware.par and the pcan_usb.dll need to be in the LaserCheck folder.

7.4.1. Driver parameters for Lexium ILS1

The general setup of each motor must be done by the commissioning software ***Lexium CT*** by Schneider Electric. Download this software from www.schneider-electric.com. Within this installation you will also find the manuals for this motor. Normally the motors are set up by data M. If there are any problems, follow these steps:

1. Set-up the CAN address for each motor via the dib switches
   1 – front/left, 2 – back/left, 3 – front/right, 4 – back/right
   The CAN addresses should match the sensor numbers and the motor numbers. Sensor 1 should have motor 1 with CAN adress 1.
2. Set the baud rate to 250KB for all motors (this is the default setting)
3. Start the Lexium CT program
4. Define the direction of rotation **invertDir. All motors must reference themselves to the negative limit switch on the left.**
   Changing the direction of rotation is only implemented after the power has been switched off and the motors have been restarted!
5. Define the phase currents for **I_still, I_acc, I_const, I_stop.** Default values are:
   I_still = 70%, I_acc, I_const and I_stop = 100%.
6. Configure the I/Os
   Standard values: IO0_def Input LIMP, IO1_def Input LIMN, IO3_def is REF. The negative limit switch (on the left side of the machine) must be connected to IO1, the positive limit switch to IO0 and the reference switch to IO3.
7. **SignEnabl** must be set for all connected limit switches and **SignLevel** for signal inversion. Generally all switches should be contact breakers; **SignLevel** is deactivated for all inputs.
8. Define **RefSWMod** according to the reference direction.
   Processing sequence during reference movement to REF

   Bit0: direction of movement withdrawal path
   0: Withdrawal in positive direction
   1: Withdrawal in negative direction

   Bit1: direction of movement safety distance
   0: in positive direction
   1: in negative direction
   Default value is 0.

   All changes you make via the Schneider-program are only saved if you temporarily disconnect the 24V power supply after programming.
9. Define LaserCheck parameter 169 in LaserCheck.par
   Start of referencing mode
   action object: Write access triggers reference movement from
   1: LIMP
   2: LIMN
   3: REF neg. direction of rotation
   4: REF pos. direction of rotation
   5: Index pulse neg. sense of rotation
   6: Index pulse pos. sense of rotation
   Comments: 5 and 6 only supported from drives with index pulse

7.4.2. Electrical installation

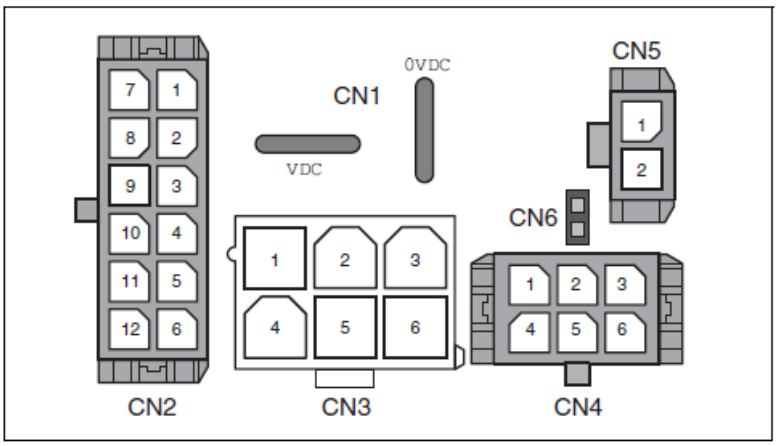


Figure 6.2 Overview of all connections

Connection	Assignment
CN1	Supply voltage VDC
CN2	Interface for PROFIBUS DP
CN3	Interface for CAN or RS485
CN4	24 V signal interface
CN5	Interface for STO safety function
CN6	Jumper for disabling STO safety function

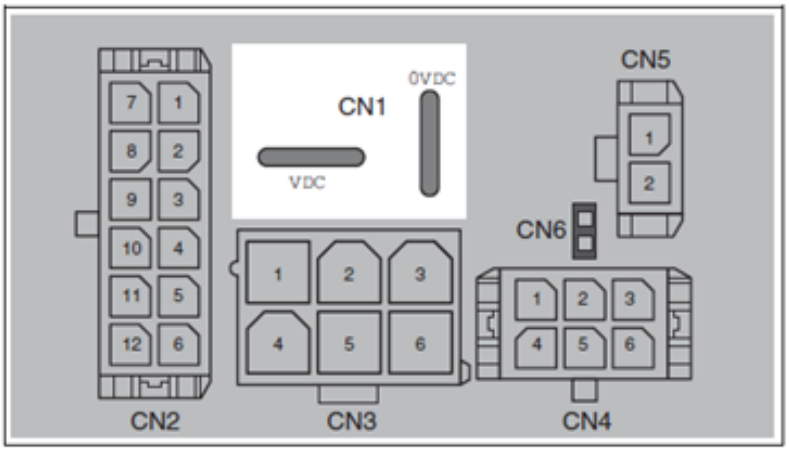


Figure 6.6 Pin assignment supply voltage

Signal	Meaning	Number 1)
VDC	Supply voltage	1
0VDC	Reference potential to VDC	2

1) Information relates to pre-assembled cables

Figure 75: Connectors of the CAN-motor

7.4.2.1. Configuration and Connection of a HS-CAN

Every device in the network is identified by a unique node address which can be set as desired. The address and baud rate are adjusted via DIP switches.

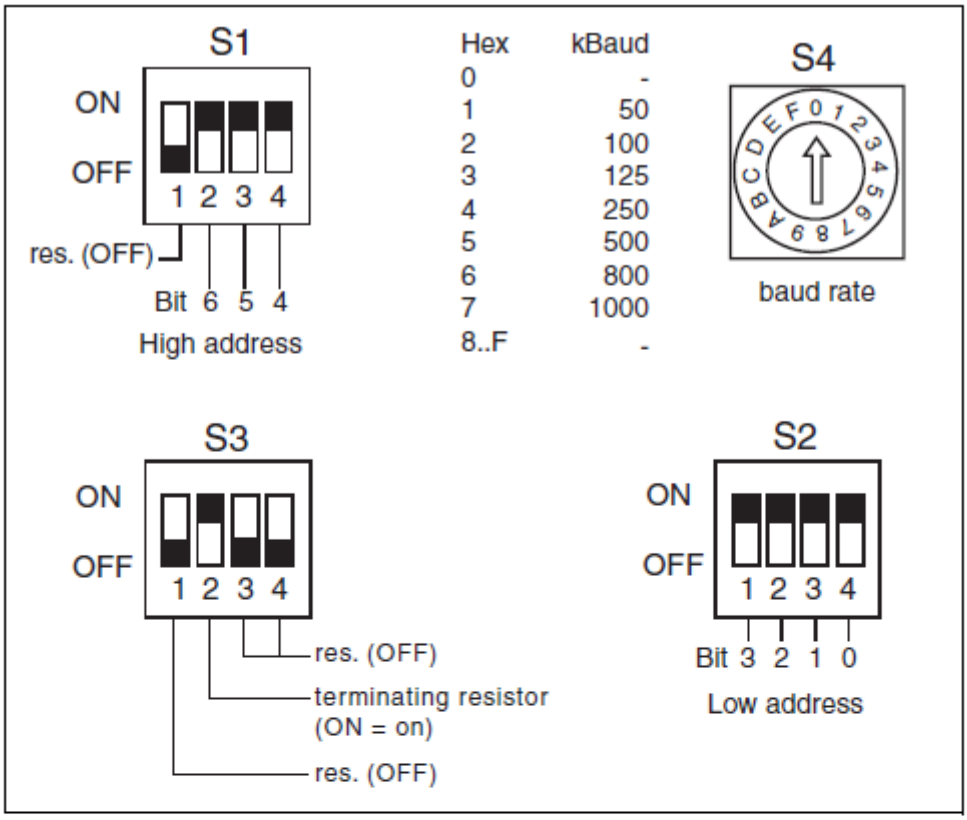


Figure 6.12 Parameter switch

Switch settings S1 and S2:	S1.2	S1.3	S1.4	S2.1	S2.2	S2.3	S2.4
Address bit:	6	5	4	3	2	1	0
Fieldbus address 127 (default)	1	1	1	1	1	1	1
Fieldbus address 25 (example)	0	0	1	1	0	0	1

Switch setting S4	Baud rate (Kbaud)
1	50
2	100
3	125
4	250
5	500
6	800
7	1000

Figure 76: Dip switches for CAN settings

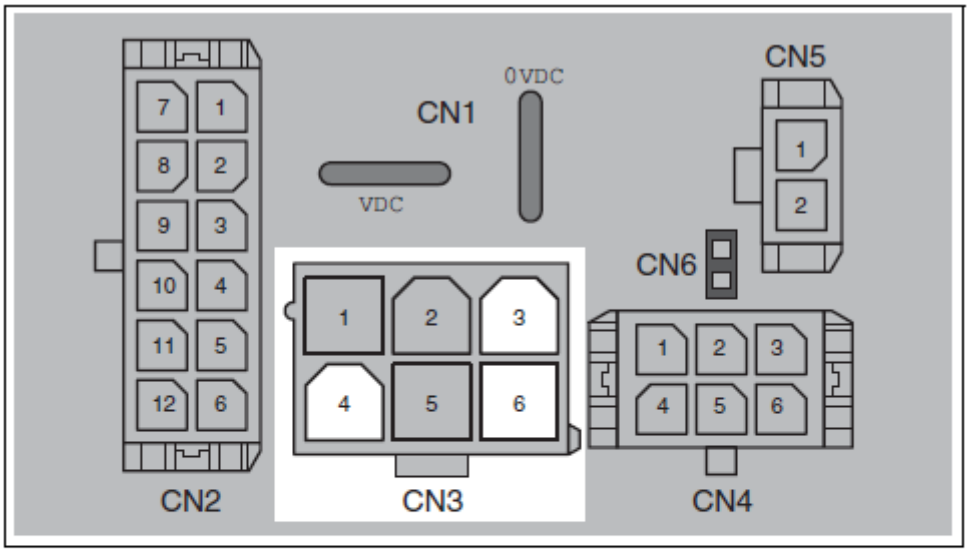
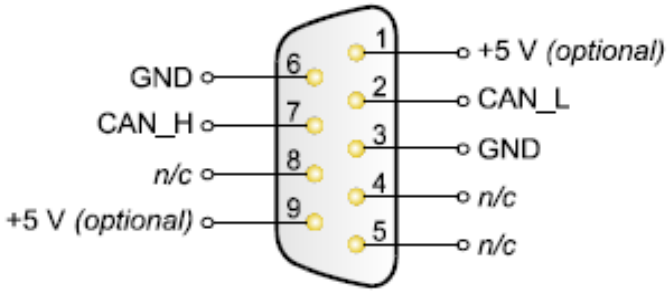


Figure 6.13 Pin assignment of CAN fieldbus interface

Pin	Signal	Meaning	SUB-D [1)]
3	CAN_H	CAN interface	7
6	CAN_L	CAN interface	2
4	CAN_0V	Internally connected to CN1.0VDC	3

Figure 77: CAN bus connector in IFS1



n/c = not connected

Figure 2: Pin assignment HS-CAN
(view onto a male connector of the PCAN-PCI card)

Figure 78: CAN bus connector at PEAK USB adapter

7.4.2.2. Pin assignment of the 24V signal interface

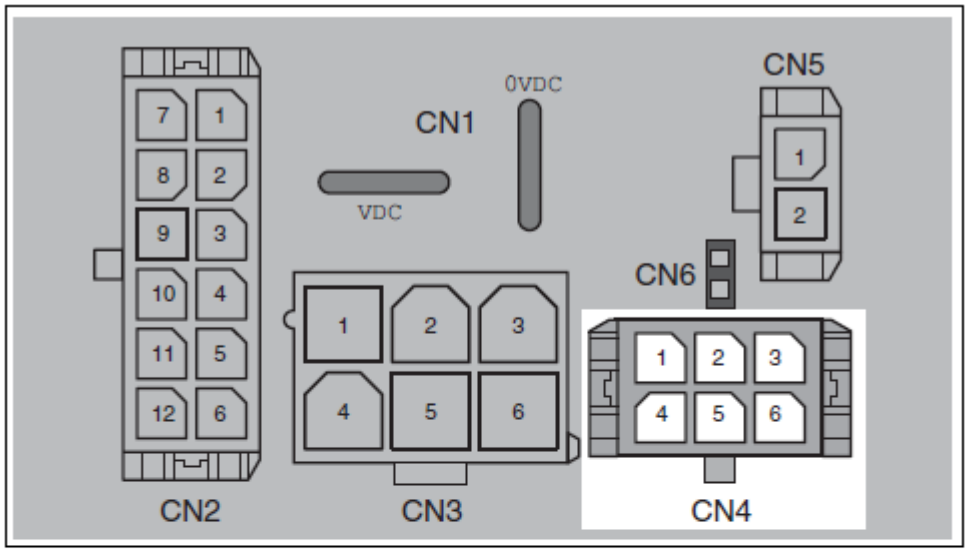


Figure 6.18 Pin assignment of the 24V signal interface

Pin	Signal	Meaning	I/O
1	+24VDC_OUT	The 24V signal supply may be used to supply the sensor system (e.g. limit switches)	O
2	IO2	Freely usable input / output	I/O
3	IO0	Freely usable input / output	I/O
4	0VDC	Internally connected to CN1.0VDC	
5	IO3	Freely usable input / output	I/O
6	IO1	Freely usable input / output	I/O

Figure 79: Connector for the limit switches

7.4.3. Working Principle

The LaserCheck system communicates with the press brake control and receives position information for the longitudinal adjustment of the sensors.
The LaserCheck longitudinal adjustment control processes this information (+offsets...) and calculates the new sensor positions.
The system starts the positioning procedure automatically when the press brake control demands an angle from the LaserCheck device and the actual sensor position differs from the desired position. Optionally, the sensors can move back to their parking position as soon as the bending process is finished.
We can operate 1 or 2 sensors with different positioning modes. If the Delem bending method 3 is used, the parameters of the sensor positions Z1 and Z2 are used to position the sensors. LaserCheck parameter 157 and the sub method 3 define the positioning mode:

- Mode 0
  Move to positions when new Delem data is received
- Mode 1
  The sensors either move to the positive (right sensor) or the negative (left sensors) offset position when new Delem data is received. When the Delem REQUEST BENDANGLE command is received, sensors are automatically moved to their positions without an offset

- Mode 2
  Sensors either move to the positive (right sensors) or the negative (left sensors) offset position, when new Delem data is received.
- Subbend method 3 or mode 3
  Move to the position when a Delem REQUEST for BENDANGLE data is received. If subbend method 3 is received, the LaserCheck parameter 157 will be ignored.

If Parameter 161 is 1, the sensors will move back to their home position after the last step of the current bending cycle, otherwise the sensor will stay at their current position.

7.4.4. Parameters from LaserCheck.par

Depending on the machine some LaserCheck machine parameters must be set up before using the system:

```
150 : 1              1              // Width control of longitudinal adjustment; Number of CAN Axes
151 : 0              0              // Max. moving distance [mm] axes 1 and 2
152 : 0.1    0.1     0.1    0.1     // Tolerences of positions [mm] axes
153 : 222.3  222.3   222.3  222.3   // Encoder increments [Incs]/[mm] axes
154 : 400            100            // Moving and reference speed[m/s] für longitudinal adjustment
155 : -290   490     4170   3400    // Zero point offset [mm] axes
156 : 0      500     4000   3400    // Parking position [mm] axes
157 : 0                             // Calculation Modes for positioning 0,1,2, use 2 Sensors like 4
Sensors (1), don`t swap left and right angles(1)
158 : 0              300            // Machine center and positioning offset [mm]
159 : 0              4000           // Min. and max. sensor position [mm] for positioning
160 : 0                             // Counter für Timeout in 5ms cycles
161 : 0                             // Move sensors to park position after each bend
162 : 192                           // Input mask
163 : 300                           // Min. sensor distance [mm]
164 : 0              0              // Reference left(0) or right(1) axes 1 and 2
165 : -290   490     -290   490     // Min. position of axes
166 : 4170   3400    4170   3400    // Max. position of axes
167 : 222.3  222.3   222.3  222.3   // Motor increments [Incs]/[mm] axes
168 : 20                            // Timeout[s] longitudinal adjustment
169 : 3      3       3      3       // Reference mode axes: 1: LIMP, 2: LIMN, 3: REF neg., 4 : REF
pos.
```

The coordinate system for the longitudinal adjustment is the same as the machine coordinate system.

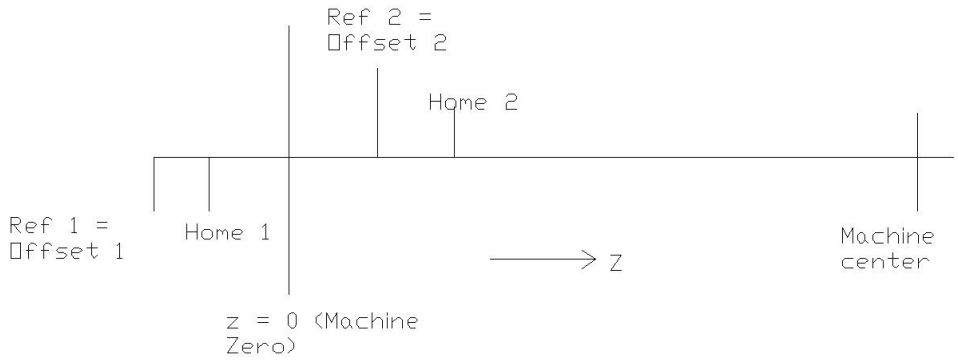


Figure 80: Coordinates for a system with 4 sensors

7.4.5. Setting Up and Testing the Sensor for Longitudinal Adjustment

The adjust and test dialog for the longitudinal adjustment can be opened in the menu **Options/Longitudinal Adjustment.** The following options are available:

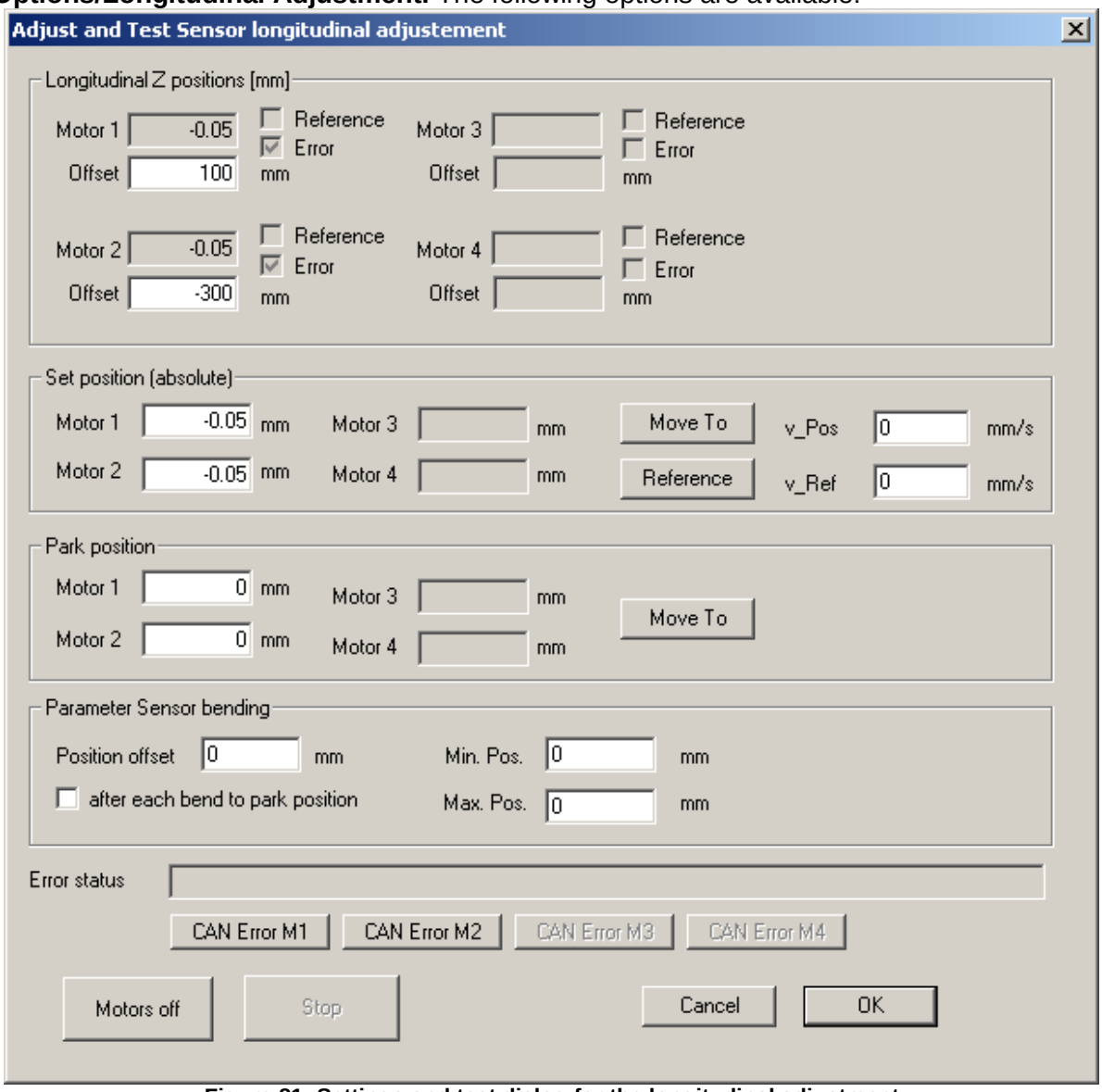


Figure 81: Settings and test dialog for the longitudinal adjustment

- The current sensor positions can be read from the **Longitudinal Z positions [mm]** field. The offset values refer to the reference positions. If you change this value, you must **reference** the **longitudinal adjustment** again. The check marks of each motor indicate its error and reference state.
- After being referenced, the system can be positioned by using **Set position (absolute)** and the **Move To** button**.** The Fields **v_Pos** and **v_Ref** indicate the speeds for referencing and normal positioning**.**
- In the field **Park position** you define a position for the longitudinal adjustment, to which the sensors will move when they are requested to move to their parking position.
- The **Position offset** value is added to (or subtracted from) the target positions, sent from the press brake control.

If a motor error is indicated, you can obtain a detailed error message by pressing the according **CAN Error M**x button.

Remark: If you want to reuse changed parameters after the next program start, you will need to save them!

8. Material Surface Control

In the dialog **Correction factors for materials and sensors** (*Ctrl + K*) you can enter individual correction values for all sensors. In addition to that you can define various camera settings for as many material types as you like.

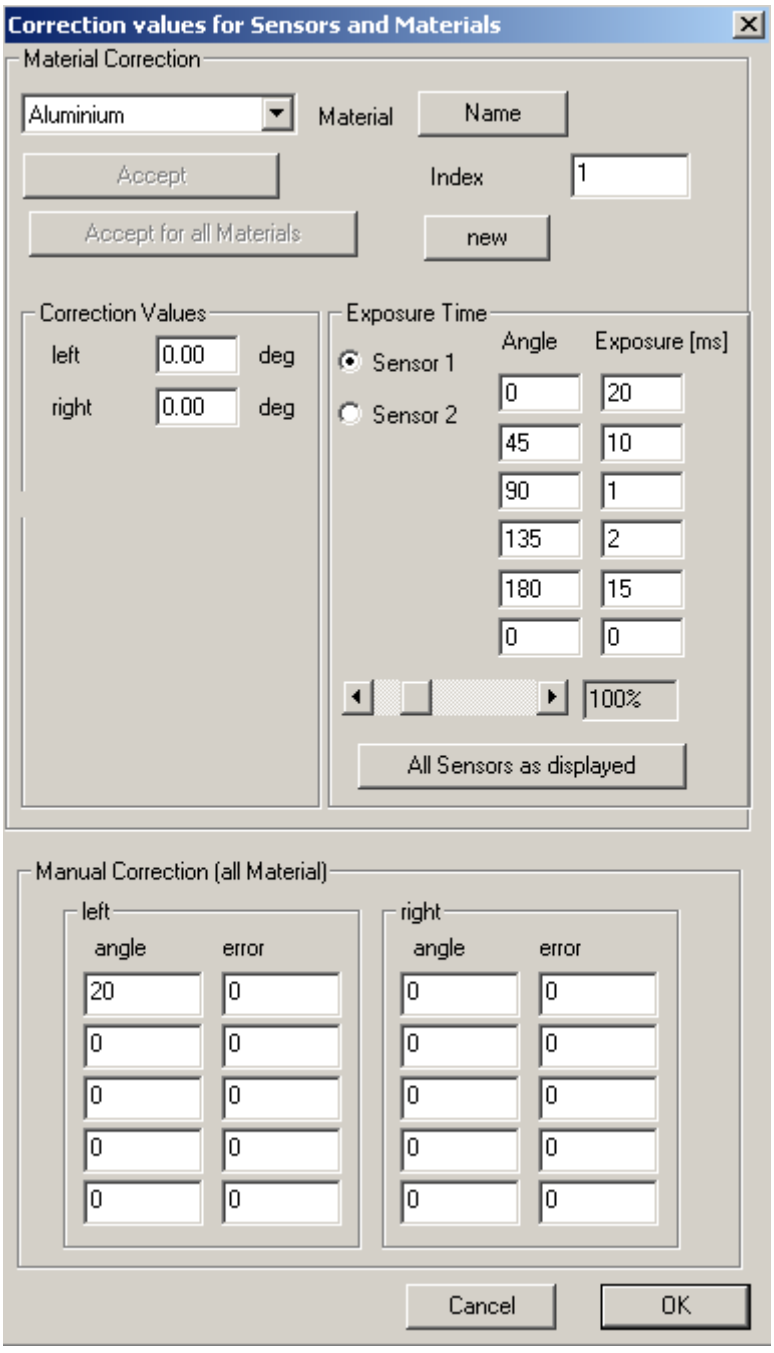


Figure 82: Dialog for correction values for sensors and materials

Five different materials have been programmed. The names of the materials are defined in KALIB.DAT, they can however be changed by clicking on **Name**. Also you can add as many new materials as you need by clicking on the button **new**.
For each material you can define a constant **correction value** for the left and the right sensor that is added to the measured value.

Exposure Time:
You can input different exposure times for up to 6 different angles. Between these values the exposure times are interpolated. Typical values are 5ms with direct reflection (90°) and 20ms with indirect refection (0° and 180°), as shown in the picture above. Activate the changes with the **Accept** button. If you want to use the current values for all materials, you can do so by clicking on **Accept for all Materials** (not recommended – for special cases only).
You can deposit a table for each camera. Otherwise you can set up a sensor and click on **All Sensors as displayed**. The slide control allows for a simple, proportional alteration of the exposure times of the camera.
The **Manual Correction (all Materials)** allows you to input individual correction values for up to 5 angles. Between these angles the correction is interpolated. This correction is valid for all materials and all dies.
If you use a LaserCheck system with **variable AOI, meaning LaserCheck 8, 9, 10, 11,** we recommend using the manual correction from the Angle Correction window. You can access it by going to **Options/Angle Measurement** and clicking on **correct**. See 5.4 Correcting the Calibration on page 76.

9. Automatic Write Protection (EWF)

After inputting an unlimited license code, the system will automatically activate a write protection on drive C:\ of the CF card.
Therefore the system will reboot. After the reboot it is still possible to save data onto the drive, but it will be saved in a shadow ram that is lost during a new reboot. If you would like to permanently install something on drive C:\, you have to run the batch file ***D:\data M Engineering\!Plus\unprotect.bat***. After a reboot, you can install or remove software or change registry items etc. Afterwards you should run ***D:\data M Engineering\!Plus\protect.bat*** and reboot the system in order to reactivate the write protection.
To check whether the write protection is active, use ***D:\ data M Engineering\!Plus\status.bat***. The protection is on, when “State” is “ENABLED”
With a write protection enabled you can switch off the computer without shut down.
Drive D:\ contains all the LaserCheck data and is not protected. LaserCheck parameters (lasercheck.par) can be deleted. It is highly recommended that you make an image of the CF card after finishing the setup. We recommend using ghost (Symantec) to make this image. For this, open the LaserCheck computer´s cover, remove the CF card and put it in a CF card reader.

10. Contents of the LaserCheck-folder

Since the folder D:\data M Engineering\LaserCheck contains a lot of data, here is a quick overview of the functions of some of the most important files.

The **Calibration**-folder contains backup-files of the Kalib.dat data, so that changes can be undone.

The **Cybelec**-folder contains **datam.cyb**. You have to copy this file to the press brakes drive D:\. Please also use the information given in 1.6.4 Installing LaserCheck Software on ModEva 15 on page 41.

The **Delem**-folder contains the folder CE5 with **DATAM.dll** and the folder CE6 with **DATAM_UAP_CE6_UDP.dll**. Please also use the information given in 1.5.4 UAP on page 28.

The **Data**-folder contains the Kalibmatrix-files for each tool for each sensor. These files are created when the sensor is calibrated while the option “short flange compensation” is active.

The **Documentation**-folder contains the most recent version of the LaserCheck-Manual.

The **Driver**-folder contains lasercheck.sys

The **Logs**-folder contains the log files. You can create a log file by clicking on the connection -window and then selecting Options/Log file. Within the log file you can read the protocol of the communication with the press brake control.

The folder **rdgb VC10** contains files for the remote debugger.

The **Registry**-folder contains the file **autologin.reg**. Normally you should **not execute** this file. It is used to create an automatic login for the standard user “LaserCheck”, in case more than one user exists on the LaserCheck-computer.

The file **CANOpenStack.dll** file is used for every hardware -communication except USB. If this file is missing, you cannot control the motors any more, e.g. for LaserCheck 6 or when using longitudinal adjustment.

The file **ewfapi.dll** is used for the EWF (writing protection). See page 95.

The file **Hardware.par** contains additional information for the CANOpenStack.dll.

LaserCheck.par contains parameters for LaserCheck. **Do not manipulate this file manually!** If you change any parameter, e.g. exposure time, the change is saved to this file.

The file **MEGSV.dll** is used for the communication with the force amplifier via a COM-port.

The file **PCAN_USB** is used for the communication with the longitudinal adjustment.

The file **res_english.dll** is the language file of the LaserCheck-program. If this file is missing, the program will be in German.

The file **USBDll.dll** is used for the communication with USB interface cards.

11. Troubleshooting

The angle is wrong
If you bend an incorrect angle, check if the problem is LaserCheck or the press brake. Take a sheet metal with a known angle and see if LaserCheck shows the correct angle. If therefore the problem is at the press brake, please create a log file and send it to support@datam-eng.de
You can find the standard log files in *D:\data M Engineering\LaserCheck\logs*. They are named mess 0.log to mess 100.log. Every time you activate the option **Log file** (F7), a new file will be created. If you deactivate the option **Log file**, the log file will be closed.

Spring back measurement is wrong

Test the positioning of Y1 and Y2. Make sure that there is no overswinging of the computed target position. Otherwise these valueswill be missing in the SB calculation. Test the positioning accuracy of the beam. It must not exceed 0.01 mm.

The monitor does not start
The chipsets Intel 82852/82855 will deactivate the external monitor, if the system has already been booted once without a monitor connected. The standard hot key for activating the monitor is <CTRL><ALT>F1.
Make sure that the keyboard is working, otherwise reboot the system with monitor, mouse and keyboard connected. Use the PS/2 connectors, as USB mouses and USB keyboards are not supported by some of our older systems.

No connection with VNC

If you connect a laptop to LaserCheck with a network cable and there is no DNS in the network, set the TCP/IP address of the laptop to 192.168.144.100. Test the connection with a ping command.
The default IP address of LaserCheck is 192.168.144.184
The default password for VNC is “!”.

Auto login

The computer is set to auto login by default. If you do change anything on the system, for example the IP-address, it is possible that a password will be requested during the startup. The password for the user “LaserCheck” is “lasercheck”. The user LaserCheck is an administrator. If any other user is logged in, the standard password for LaserCheck will be deleted.

12. Safety and Maintenance Instructions

- Do not look into the laser beam, not even with optical instruments. It may cause injuries to your eyes.
- The operator must be trained for working with the machine on which the angle measurement system is installed. Improper use can cause heavy damage to the equipment and injuries to people.
- Modification of machine parameters can cause material damage or lead to irregularities in the quality of the product.
- The computer housing may only be removed by a qualified technician (danger of electric shocks).
- Do not expose the control to excessive humidity so as to avoid any risk of electric shocks and any deterioration of the equipment.
- Make sure that the control is disconnected from the main power before carrying out any cleaning. Do not use liquids based on alcohol or ammoniac.
- In the case of a malfunction of the control, call a technician.
- Do not expose the control to direct solar radiation or to any other heat source.
- Do not place the control close to any magnetic equipment such as transformers, motors or devices which generate interferences (welding machines, etc.)
- Replace fan filters in regular intervals so as to avoid overheating.

12.1. Safety of Laser Devices

12.1.1. Safety Instructions

The work space, in which the laser is mounted, has to be flagged in accordance with the legal requirements, in order to avoid any inadvertent damage of third parties. The optical path should be kept clear of mirrors, as dangerous reflections may occur. In the case of a malfunction, the device has to be shut down immediately.

12.1.2. General Instructions

Safety instructions serve for occupational safety and avoidance of accidents. They must be followed! In order to prevent you and your colleagues from injuries, YOUR co-operation is also required. Please always work with care and be aware that dangers are often not "obvious". In order to ensure a safe operation, the operator has to make sure, that people working with or around the device have been informed about the potential dangers associated with laser radiation. You can protect yourself from avoidable damages if you are familiar with the following national cooperative regulations for the prevention of industrial accidents:

UVV "Electrical installations and equipment" (BGV A2/VBG 4)

UVV "Laser radiation" (BGV B2/VBG 93)

UVV "Safety labelling at work" (BGV A8/VBG 125)

You can get the documents from your occupation co-operative or you can download them e.g. at **www.hvbg.de**. These documents refer to the regulations in Germany. Additionally, there is a reference to the norm EN 60825-1/VDE- or VDE 0837 (as of November 2001) "Safety of laser devices". Attention should especially be paid to paragraph three - guidelines for users! The norm is available at the publishing company Beuth GmbH, Burggrafenstrasse 6, 10787 Berlin, Germany. In countries other than Germany you have to follow the regulations that correspond to the German UVVs and norms.

12.1.3. Laser Classes

The laser class is given on the yellow or black/white/red (USA) warning label, which can be found on every laser or on it's tightly screwed dimming cap. Never remove this warning label! It is absolutely necessary that the safety measures corresponding to the respective laser class are complied with (see UVVs and norms). An extract from the EN 60825-1, safety of laser devices, Chap. 12.5 Laser devices in laboratories and at the place of work (p. 48) is here for your information:

In analogy to EN 60825-1, safety of laser devices, table D.3 - Summary of the precautions users should take:

Requirements	Class 1	Class 1M	Class 2	Class 2M	Class 3R	Class 3B
Laser safety officer*	Not required, but recommended for applications which demand a direct look into the laser beam				Not required for visible emissions	Required
Interlock, operatable by remote control	Not required					To be connected to room or door circuits
key switch	Not required					Pull out key if device is not operating
Beam reducer	Not required					Avoids unintentional exposure to beams when operating
Beam indication	Not required				Indicates, when the laser is operating with invisible radiation	Indicates if the laser is operating
Laser warning labels See labels on the laser!	Not required					Follow the indications on the warning labels
Beam paths	Not required for laser classes 1 and 2. For 1M, 2M: Measures as for 3R, 3B					The beam has to finish at the end of its expedient way
Mirroring reflection	Not required for laser classes 1 and 2. For 1M, 2M: Measures as for 3R, 3B				Unintended reflections are to be avoided	
Eye protection	Not required					Required, if constructive or organisational measures are not workable or if permitted max. radiation is exceeded
Protective clothing	Not required					
Schooling	Not required				Required for operational and maintenance staff.	

* Training courses are offered e.g. by the TÜV-Akademie Rheinland in Köln (Tel.: 0221-806-3055, Fax: 0221-806-1534,).

Figure 83: Safety of laser devices in analogy to EN 60825-1

12.1.4. Laser Devices of Class 1M, Class 2, Class 2M and Class 3R

Precautionary measures are only necessary in order to avoid continuous direct looking into the laser beam; for classes 1, 2 and 2M, a momentary (0.25 sec.) irradiation of a wave length range between 400 nm and 700 nm, as it may occur when you accidentally look into the beam, is not considered to be dangerous. However, you should not intentionally aim the laser beam at people. The use of optical aids (e.g. binoculars) together with laser devices of the classes 1M, class 2M and class 3R may increase the risk of harming your eyes.

12.2. Daily Checks

The user must check the glass filters on the front side of the sensors at least on a daily basis. In case they are not clean (scratches, oil, grease, dust etc.), use a special cleaning set for standard glasses or replace the filter.

Remark*:*

Whilst cleaning, do not look directly into the laser beam, with or without optical instruments, as it might be dangerous for your eyes.

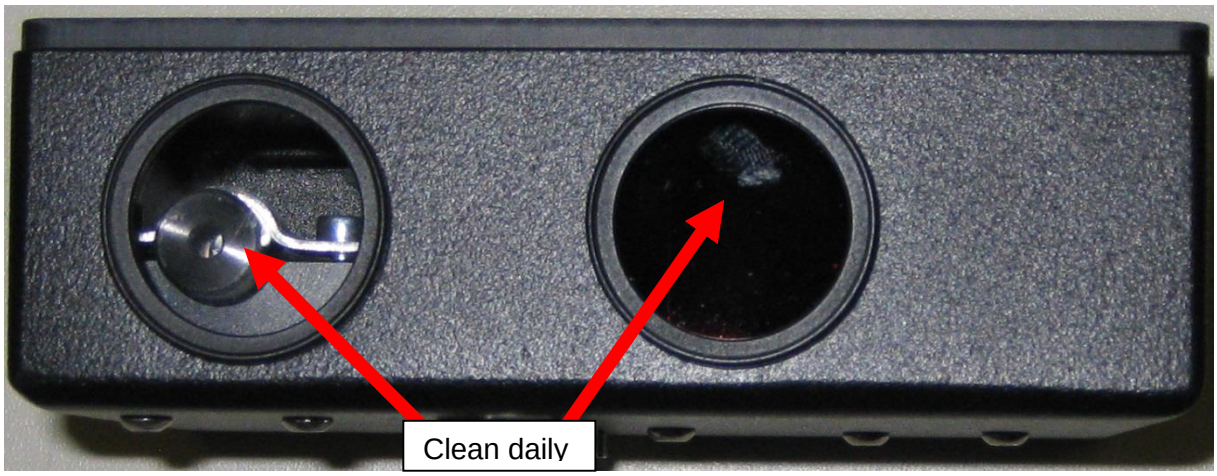


Figure 84: Front view of the Lasercheck7 sensor

12.3. Weekly Checks

- Clean the threaded bolt with petroleum. Use a nylon brush and spray it with light resin-free oil.
- Clean the guide ways and spray them with light resin-free oil.

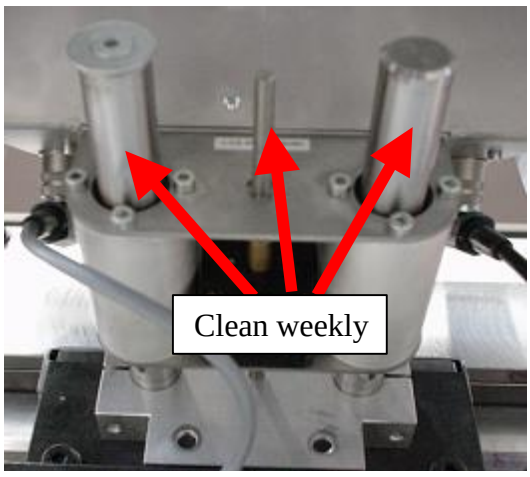


Figure 85: Guide ways and threaded bar of the LaserCheck 6 sensor

Check

- that the mounting screws are tight
- that the guide ways are parallel
- the measured angles with a metal part of known angle
- whether the connectors and cables are tight and not damaged.

If necessary, clean the control computer. Carefully remove dirt and dust from inside the housing.

13. General Specifications

Remark: Technical specifications are subject to changes without notice

Environmental Characteristics

Operating

Ambient temperature	5° to 40°C
Relative humidity (Non-condensing)	8% to 90%
Vibration (random RMS)	0.15G for horizontal 0.1G for vertical

Non-operating

Ambient temperature	-10° to 50°C
Relative humidity (Non-condensing)	5% to 80%
Vibration (random RMS)	0.5G rms (XYZ)

General System

Computer	Industrial PC with Atom D525
Housing	Mini chassis for wall mounting
Operating system	MS Windows XPE
Image processing	uEye USB Cameras
Laser	5mW Laser diode
Measuring frequency	5-6 measurements/sec
Precision per sensor	better than 0.1°
Supported controls	Delem DA 65, DA 69, DA66W, DA69W, Cybelec DNC 1200, ESA kvara, Amada, Bystronic, Modeva, Simotion
Number of sensors	2 or 4 sensors in parallel

Sensors

Laser Life Time

At 0°C	~100.000h
At 40°C	~10.000h

Safety

Laser class	2M

LaserCheck 6 Sensors

Length (mm) for max course 65mm	204
Width (mm)	206
Height (mm) with mounting block	173
Weight (kg)	3.5

LaserCheck 7 Sensors

Length (mm)	120
Width (mm)	90
Height (mm)	40
Weight (kg)	0.75

LaserCheck 8 Sensors

Length (mm)	120
Width (mm)	90
Height (mm)	40
Weight (kg)	0.6

LaserCheck 9 Sensors

Length (mm)	120
Width (mm)	90
Height (mm)	40
Weight (kg)	0.6

LaserCheck 10 Sensors

Length (mm)	105
Width (mm)	80
Height (mm)	45
Weight (kg)	0.6

LaserCheck 11 Sensors

Length (mm)	105
Width (mm)	80
Height (mm)	55
Weight (Kg)	0.7

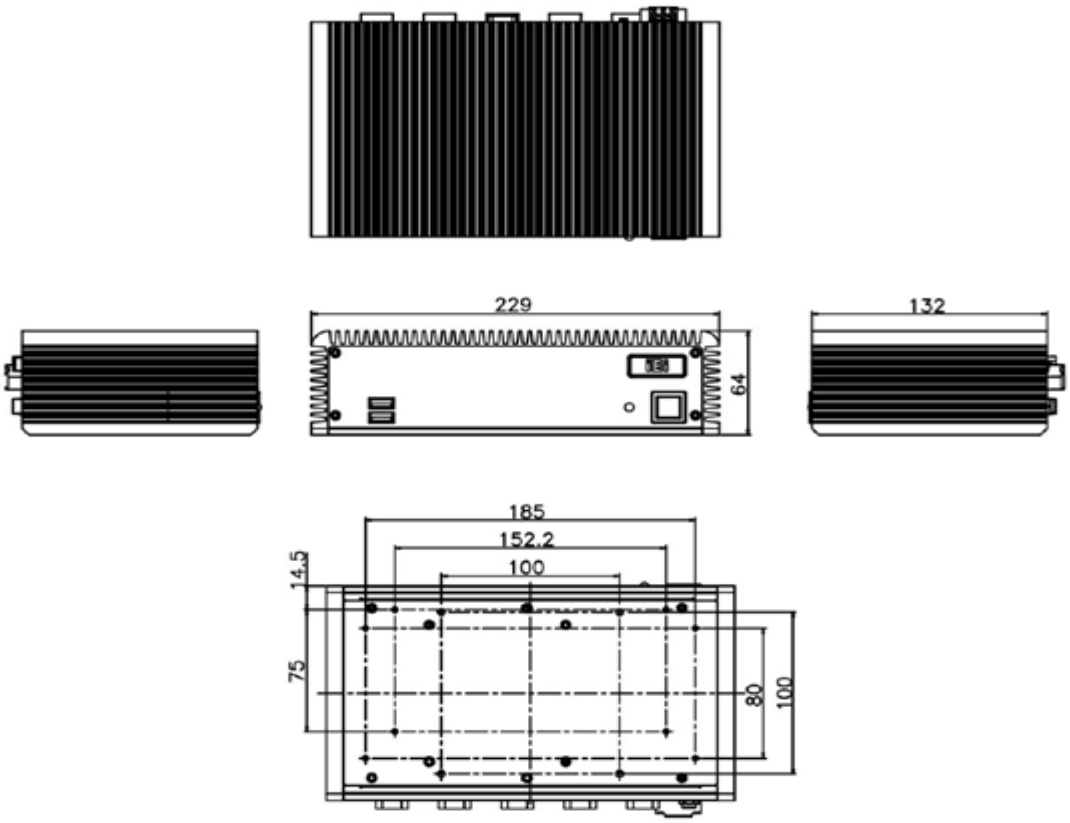
Control Computer

Power

Input voltage	24VDC input (9-26V), max. 60W

Physical Size

Length (mm)	229
Width (mm)	132
Height (mm)	64
Weight (kg)	1.7



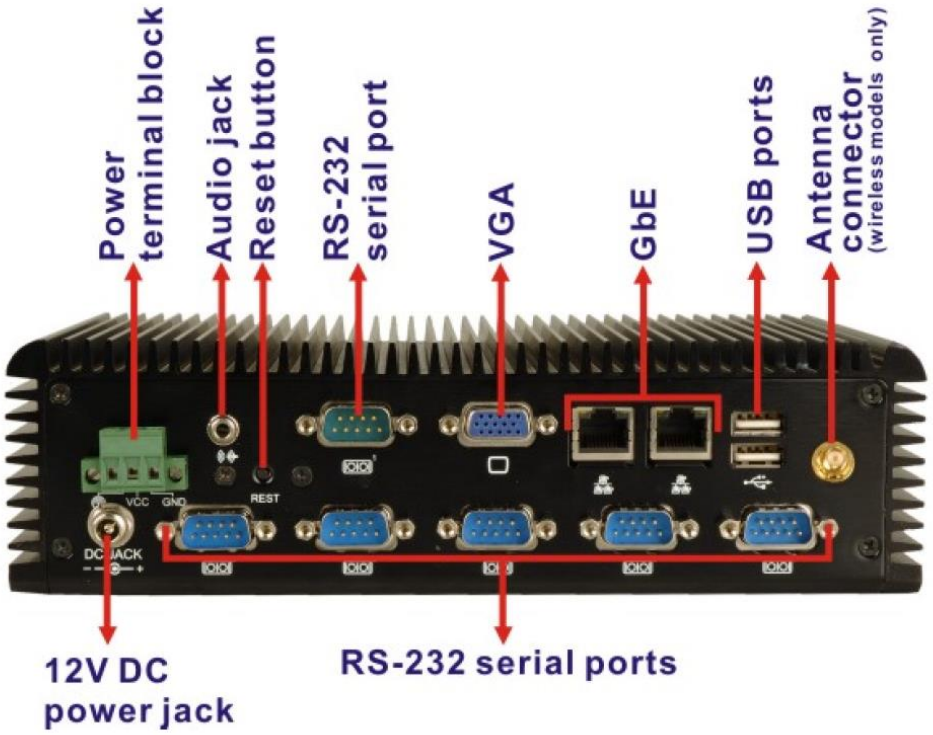


Figure 86: Back side view

Figure 87: Front side view

INDEX

A

Amplifier 7
Alignment with pressure method 17
Alignment with test bend 18
Amplification level 17
Force limit 17
Function test 13
GSV Threshold 19
Loading Test 16
ME GSV.exe 14, 16
Offset 14
AOI 74, 76
Area of Interest – AOI 74
Auto login 96

B

Bending length 6
Bending with Cybelec 50

C

Calibration correction 77
Correction material 92
Cybelec 37
Amplifier 37
Bending 50
Connection to the NLR 40
Installing Force sensors 48
Machine parameters 44
Modeva 15 41
NLR-Card 39, 40
Programming bends 50
Real Time measurement 79
Spring back measurement 52
Tandem 56
Cybelec Parameter
Closed loop cycle 46
Cybelec Parameters
200 Measurement System 44
202 Force detector 45
204 Angle min/max 45
206 Final approach 45
207 Treshold spring back 45
208 Measurement force 46
209 Compensation factor 46
211 Spring back measurement cycle 46
212 Max time sping back measurement 46
213 Spring back measurement tolerance 46
214 Advanced stop 46
215 External detection of spring back 47
216 Cycle with N measurements 47
216b Step size 47
217 Delay before measures 47
218 Number of samples 47
220 Speed spring back measurement 47
222 Measurement dynamic offset 47
Angle measuring device 50
Compensation factor 51
Error 51
Measure type 50
N 50
N2 50
RF100%, RF X%, RF0% 51
Sensor 50
Spring back corr 51
Tolerance opened/closed 51

D

Decompression speed 19
Delem 28
Bending process parameters 33
Controller setup 28
Error messages 35
Flags 29
Four sensor option 35
Log file 34
Machine parameters 30
Method 3 31
Method 4 - Learned bend 32
Network configuration 28
Sensor parameters 30
Sequencer modifications 29
Tools 36
UAP 28
Delem Parameters 30
Communication timeout 31
Compensation factor 33
Correction angle 33
Decompression distance 30
Decompression speed 30
Delay before measurement 34
Expected spring back 33
IP-Address 30
Limit of force ratio 34
Maximum allowed spring back 31
Maximum spring back 34
Minimal movement of y-axis 31
Minimum correcion distance 34
Minimum force ratio RF_{lim} 31
Mute 2 as reference 31
Overbend angle 30
Overshoot before release 31
Pre bend angle 30
Spring back measurement on 34
Steps for overbend approaching 34
Switch of messages 31
Target angle for nominal approach 34
Target angle offset 31

Target ratio for spring back calculation 34
Use treshold for spring back detection 31

E

Electromagnetic compatibility. 16
EMC 16
Error messages on Delem 35
Exposure time 93

F

Flags 29

L

LaserCheck 10 27
LaserCheck 11 27
LaserCheck 6 21
LaserCheck 6 G 22
LaserCheck 6 U 22
LaserCheck 7 ..... 23, 25
LaserCheck 8 25
LaserCheck 9 26
LaserCheck Software 64
Angle measurement 70
AOI 74
Camera settings 73
Exposure Time 78
Force double sided measurement 70
General Settings 68
Image processing 70
Laser Line detection parameters 72
Live Mode 67
Material surface 92
Mirror option 67
Mounting position of the sensors 71
Plausibility 73
Plausibility of measured angle 70
Segmentation 73
Short flange compensation 75
Short flange compensation 73
Variable AOI 76
Visualisation 71
LaserCheck TT 69
Learnt bend 29
Live mode 67
Longitudinal adjustment 68, 84

M

Machine requirements for LaserCheck 6
Maintenence 99
Material surface 92
ME GSV.exe 14, 16
Mirror-option. 67, 77
ModEva 15 41
Mounting angle 21
Mounting of the Strain gauges 7

R

Real Time measurement 53, 79
Real Time Measurement 68
Roboter 69

S

Safety 97
Safety of laser devices 97
Sensor mounting 20
Sensor V-Adaption control 80
Sequencer modifications 29
Sheet thickness 19
Short flange compensation 75
Spring back measurement on Cybelec 52
Strain gauge 7
Strain gauge offset adjustment 14
Strain Gauges 15

T

Tandem option for Cybelec 56, 69
Technical drawings
LaserCheck 10 27
LaserCheck 11 27
LaserCheck 6 21
LaserCheck 7 23
LaserCheck 8 25
LaserCheck 9 26
Trinamic stepper motor modules 23
Troublesshooting 96

U

UAP 28
UDP 28

V

V-Adaption 80
Variable AOI 76
Calibration Correction 77
Die definition 76
LaserCheck 10/11 77
Switching the AOI 76
V-height adjustment 68, 81
VNC 96
V-Width adjustment 68, 80

W

Wiring Scheme
Amplifier 10
Amplifier 37
LaserCheck 10 62
LaserCheck 11 63
LaserCheck 6 57
LaserCheck 7 61
Longitudinal Adjustment 86
Strain Gauge 10
Working distance 20, 21
Writing Protection 69, 94

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